

# Community Assistantship Program

*...a program of the Center for Urban and Regional Affairs (CURA)*

## Crow Wing County's Lakeshore Impervious Coverage Research Project

**Prepared in partnership with**  
Crow Wing County  
Land Services Department

**Prepared by**  
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Research Assistant  
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**2012**

**CAP Report # 173**

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# ***Crow Wing County's Lakeshore Impervious Coverage Research Project***

Summer 2012

## **I. Executive Summary**

The purpose of the 2012 impervious coverage research project was to determine the amount of impervious surfaces on lakeshore parcels for parcels on lakes over 1000 acres in size. The percent impervious was calculated for the entire riparian lot. The percent impervious was also calculated within 250 feet and 500 feet of the riparian lot. The percent of impervious surfaces was calculated using high resolution Lidar and aerial photography in ESRI's ArcMap software.

The final product of the impervious coverage study is a comprehensive Geographic Information System (GIS) layer of different surfaces and a calculation of the percent impervious by parcel on the selected lakes. This will help Crow Wing County in its water planning efforts, especially in regards to the effects of stormwater management. It will also help with determining what land use performance standards may be needed for future permit applicants.

## **II. Purpose**

Water is Crow Wing County's lifeblood. The county has an area of 731,000 acres and approximately 102,000 acres or 14% is covered by over 400 scenic lakes, rivers, and streams. An additional 14% is covered by wetlands as well. The abundance of surface water makes this Central Minnesota County an attraction to people.

From 1990 to 2000 the population in Crow Wing County has increased by 24.5%, the eleventh fastest growth county of Minnesota's 87. The most recent census shows the population continued to grow another 13.4% from 2000 to 2010. The majority of the growth is concentrated around the clear, deep water lakes where seasonal cabins are being replaced with larger year-round homes. With these larger homes comes the potential for more stormwater runoff into these majestic lakes.

Crow Wing County revised its Land Use Ordinance in 2011. This ordinance placed added performance standards based on the amount of impervious surfaces per lot. It is now required to have a storm water management plan if the riparian lot exceeds 15% in impervious surfaces. The ordinance prohibits more than 25% impervious surfaces in the shoreland protection zone (Article 41). This ordinance will help keep lakes clean for generations to come.

**Table 41.1 Shoreland Protection Zone Impervious Surface Limits**

<b>Development or Use</b>	<b>Maximum Impervious Surface</b>	<b>Applicable Area</b>
<b>Residential lots-with no stormwater plan required as per Article 41.2 1 A</b>	15%	Total lot area above the OHW
<b>Residential lots with stormwater plan as per Article 41.2 1 B</b>	20%	Total lot area above the OHW
<b>Residential lots with stormwater plan &amp; shoreline buffer as per Article 41.2 1 C</b>	25%	Total lot area above the OHW
<b>Conservation Developments with stormwater plans as per Article 41.3</b>	30%	Average Dwelling unit lot above the OHW
<b>Resorts with stormwater plans as per Article 34.8</b>	25%	Total project area and any tier above the OHW
<b>Commercial with stormwater plans as per Article 16.3</b>	30%	Total lot area above the OHW

This study defines the percent of impervious surfaces on individual lots. It is needed to maintain the integrity and build the foundation for future studies. We as individuals need to realize that our planning today will make a huge impact on the future. It does not take long to damage our natural resources, such as these waterways and lakes, but it will take generations to get them back to the way they are today.

### III. Process

The study began with Chris Pence (Land Services Supervisor), David Landecker (Survey Coordinator), and Mitch Brinks (Water Protection Specialist), all from the Crow Wing County Land Services Department, instructing me on the information needed for this study. The information needed was the amount of impervious surfaces within 500 feet of the Ordinary High Water. They wanted to know the different kinds of impervious surfaces such as bituminous driveways, gravel driveways, dirt driveways, grass driveways, boathouses, dwellings, sheds, garages, patios, and so on. This information will help determine future updates to the local water plan.

Using ArcMap, I created different layers for all the different kinds of impervious surfaces and began digitizing them. Layers are used to display and work with a specific GIS dataset. A layer in ArcMap represents geographical data such as a particular theme and in this case it is the impervious surfaces. In certain instances, it was impossible to see the entire building on the aerial photo. In these instances I had to use county records to find out the dimensions of the structure. The Property Valuation and Classification Office has records on all the structures in the county. Using this information I could determine the percent of impervious per lot.

In extreme instances, where aerial photography and high resolution Lidar could not be used, I would have to do some ground truthing to determine the impervious coverage. I used a Geo Explorer 6000 GPS unit to calculate the amount of impervious. I also needed to ground truth parcels that were completed using ArcMap. The reasoning for this was to determine how accurate the calculations are by using the GIS software.

#### IV. Results

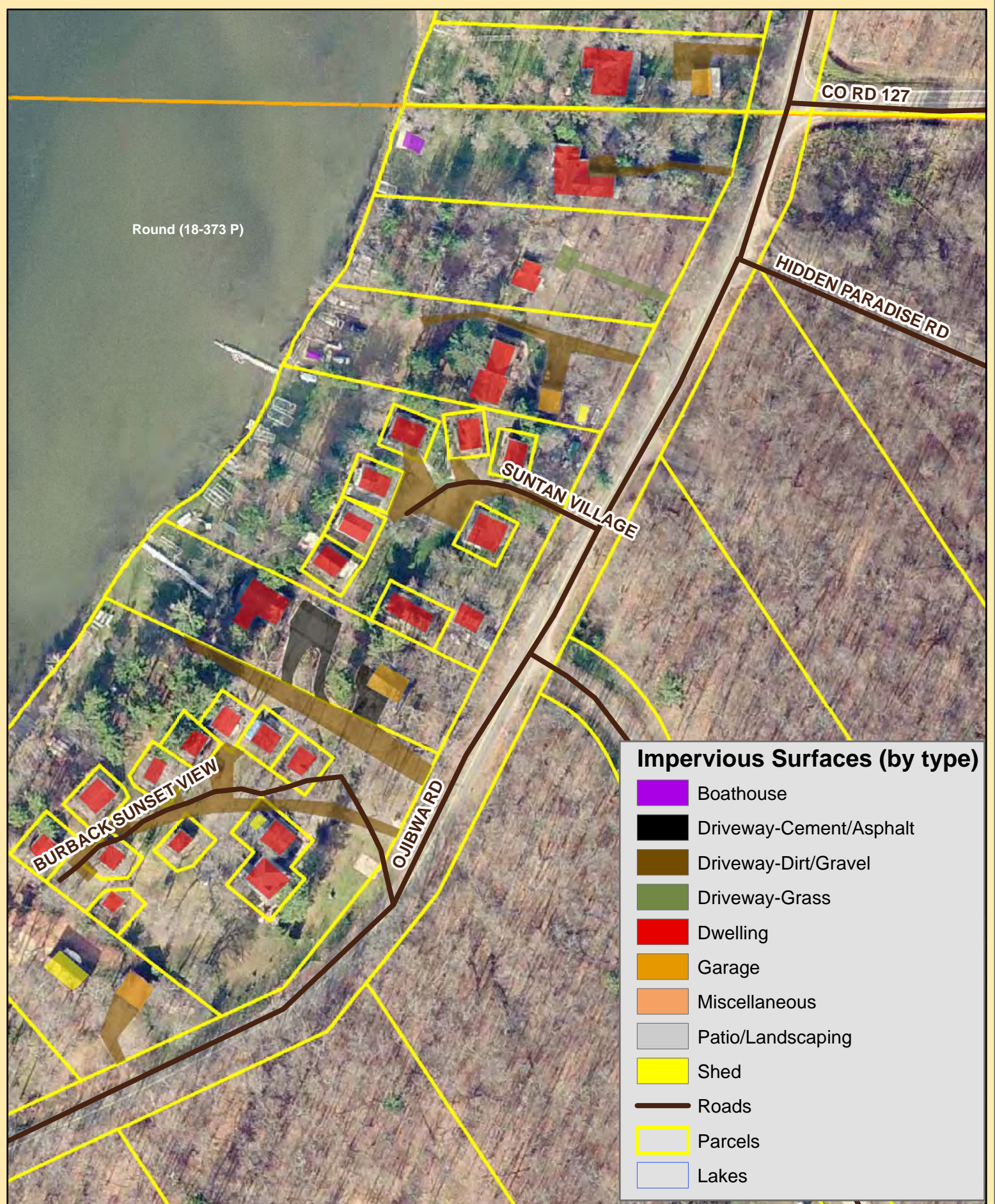
To confirm that the interpreted computed calculations would be correct using this software I had to ground truth several parcels. During the ground truthing process, I used a Geo Explorer 6000 GPS unit to calculate the percent of impervious surfaces and then compared them with the findings in ArcMap. The parcels that were ground truthed established that the percent impervious range was 0-2% from the calculated percent using the ArcMap software. We found this to be an acceptable level of deviation. Now that we have this data we can continue to track the percent of impervious on these lakes to determine future plans for this growing county.

## V. Appendices

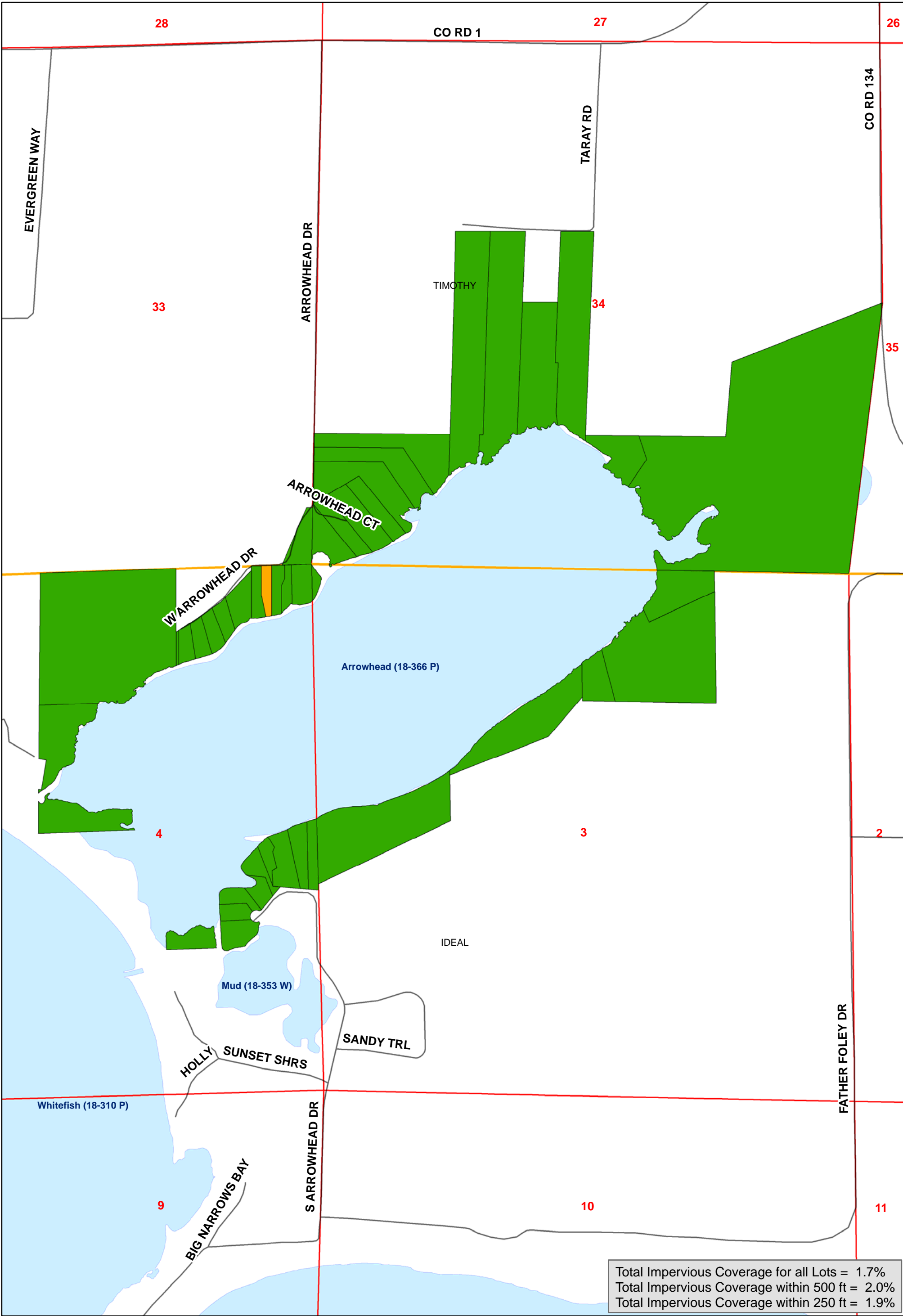
Lake Name	# of Riparian Lots Per Lake	% Imp Within 250' of OHW	% Imp Within 500' of OHW	Average % Imp Per Lot
Borden	236 Lots	5.0%	4.1%	2.8%
Platte	340 Lots	5.2%	4.0%	2.3%
Upper Hay	303 Lots	8.6%	8.0%	5.6%
Lower Hay	202 Lots	6.8%	6.7%	5.9%
Bertha	173 Lots	10.7%	11.4%	10.5%
Pig	86 Lots	3.1%	2.4%	1.9%
Arrowhead	44 Lots	1.9%	2.0%	1.7%
Big Trout**	88 Lots	7.1%	7.0%	5.4%
Rush**	57 Lots	12.7%	13.7%	13.7%
Hubert**	122 Lots	11.8%	9.0%	6.4%
Round**	219 Lots	13.0%	14.6%	14.5%
Whitefish**	745 Lots	6.3%	6.2%	4.8%

\*\* Some parcels not included because they are located inside city limits.









Arrowhead Lake

Impervious Surface Coverage by Parcel

- 0 - 15 %

15 - 20 %

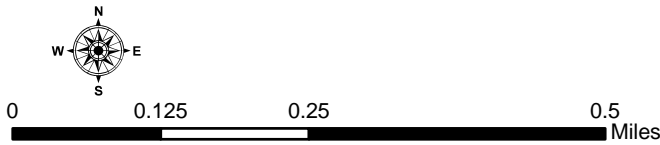
20 - 25 %

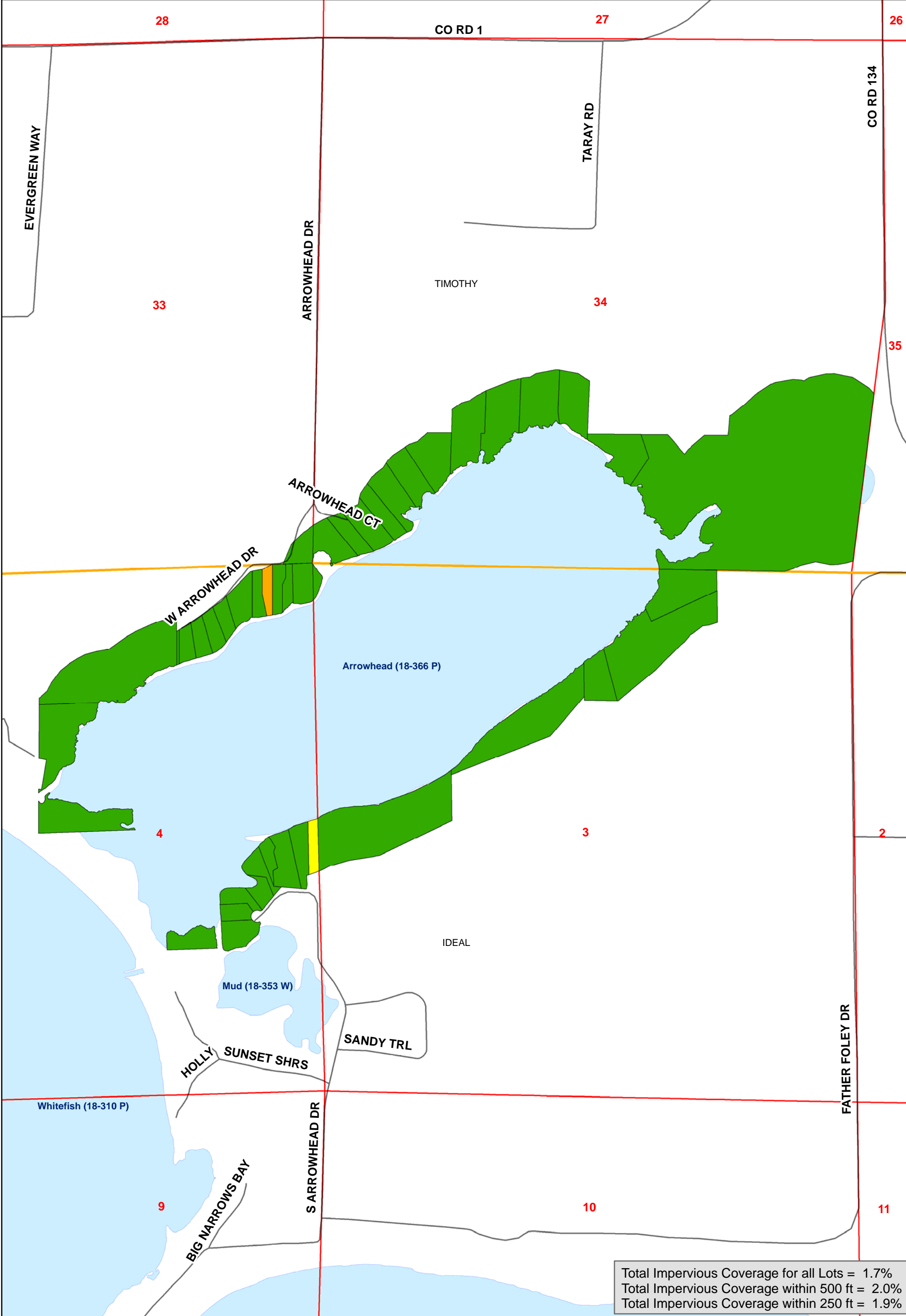
25+ %
- Section Lines

Roads

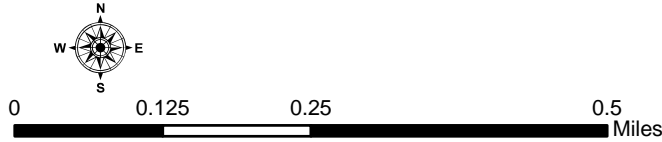
Lakes

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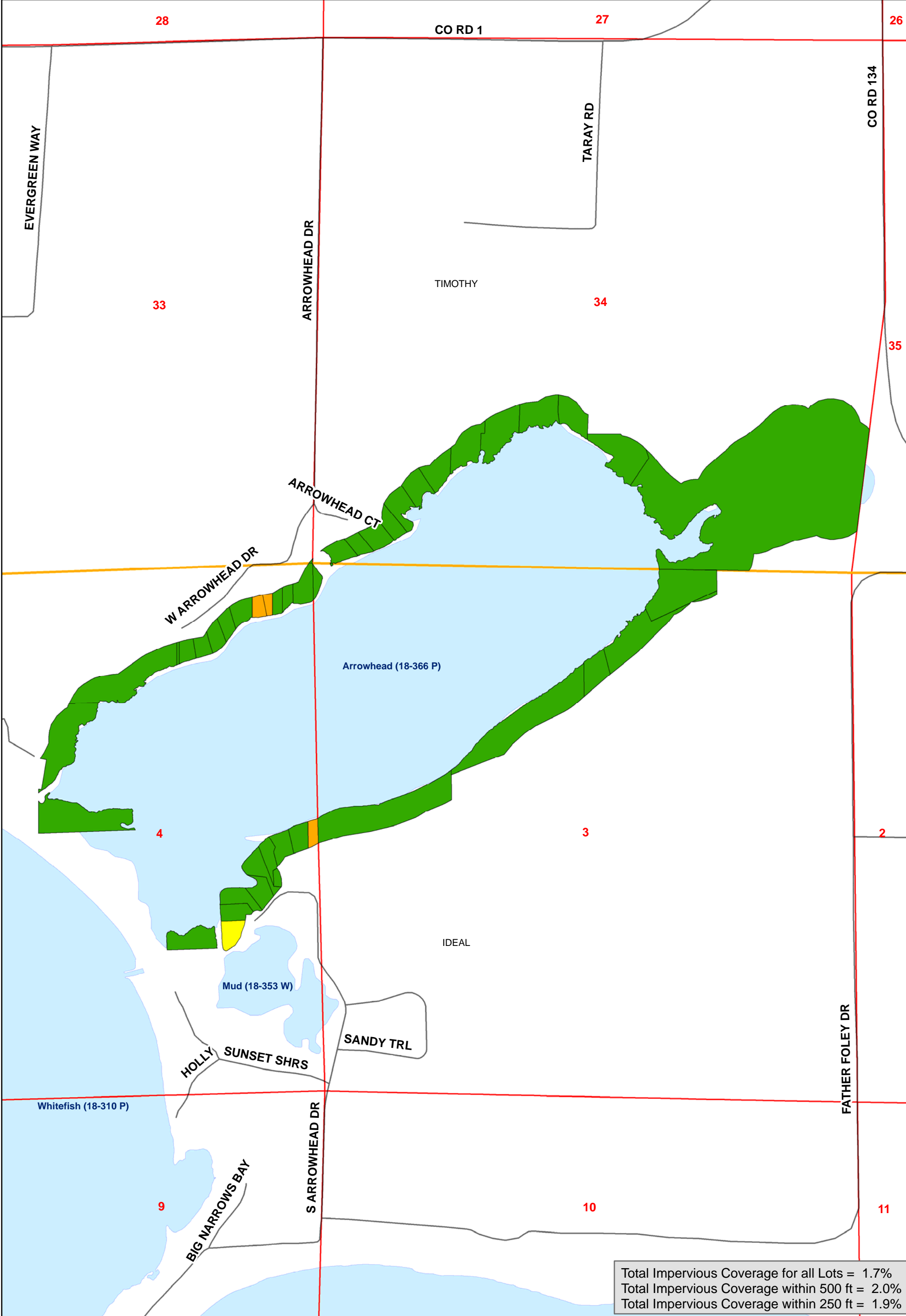
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# Arrowhead Lake

## Impervious % within 500 ft of Shoreline








- |  |           |  |               |
|--|-----------|--|---------------|
|  | 0 - 15 %  |  | Section Lines |
|  | 15 - 20 % |  | Roads         |
|  | 20 - 25 % |  | Lakes         |
|  | 25+ %     |  |               |



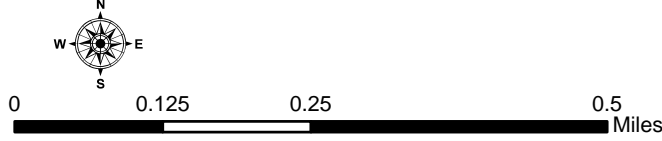
Total Impervious Coverage for all Lots = 1.7%  
Total Impervious Coverage within 500 ft = 2.0%  
Total Impervious Coverage within 250 ft = 1.9%

# Arrowhead Lake

## Impervious % within 250 ft of Shoreline

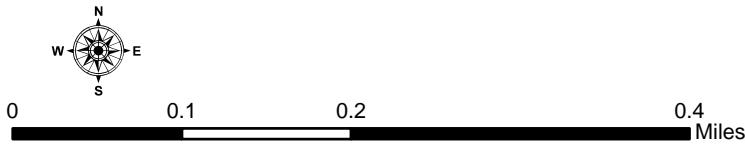
- |   |           |   |               |
|---|-----------|---|---------------|
|  | 0 - 15 %  |  | Section Lines |
|  | 15 - 20 % |  | Roads         |
|  | 20 - 25 % |  | Lakes         |
|  | 25+ %     |   |               |

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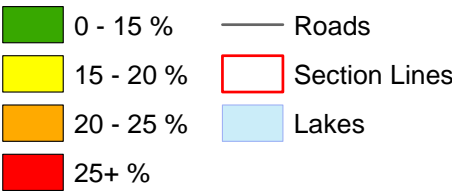


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# Lake Bertha

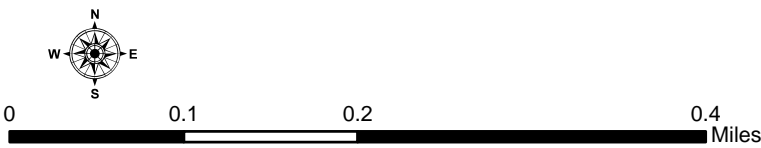
## Impervious Surface Coverage by Parcel







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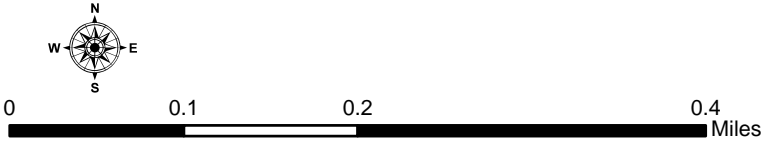
# Lake Bertha

## Impervious % within 500 ft of Shoreline

- 0 - 15 %
  - 15 - 20 %
  - 20 - 25 %
  - 25+ %
- Roads
- Section Lines
- Lakes



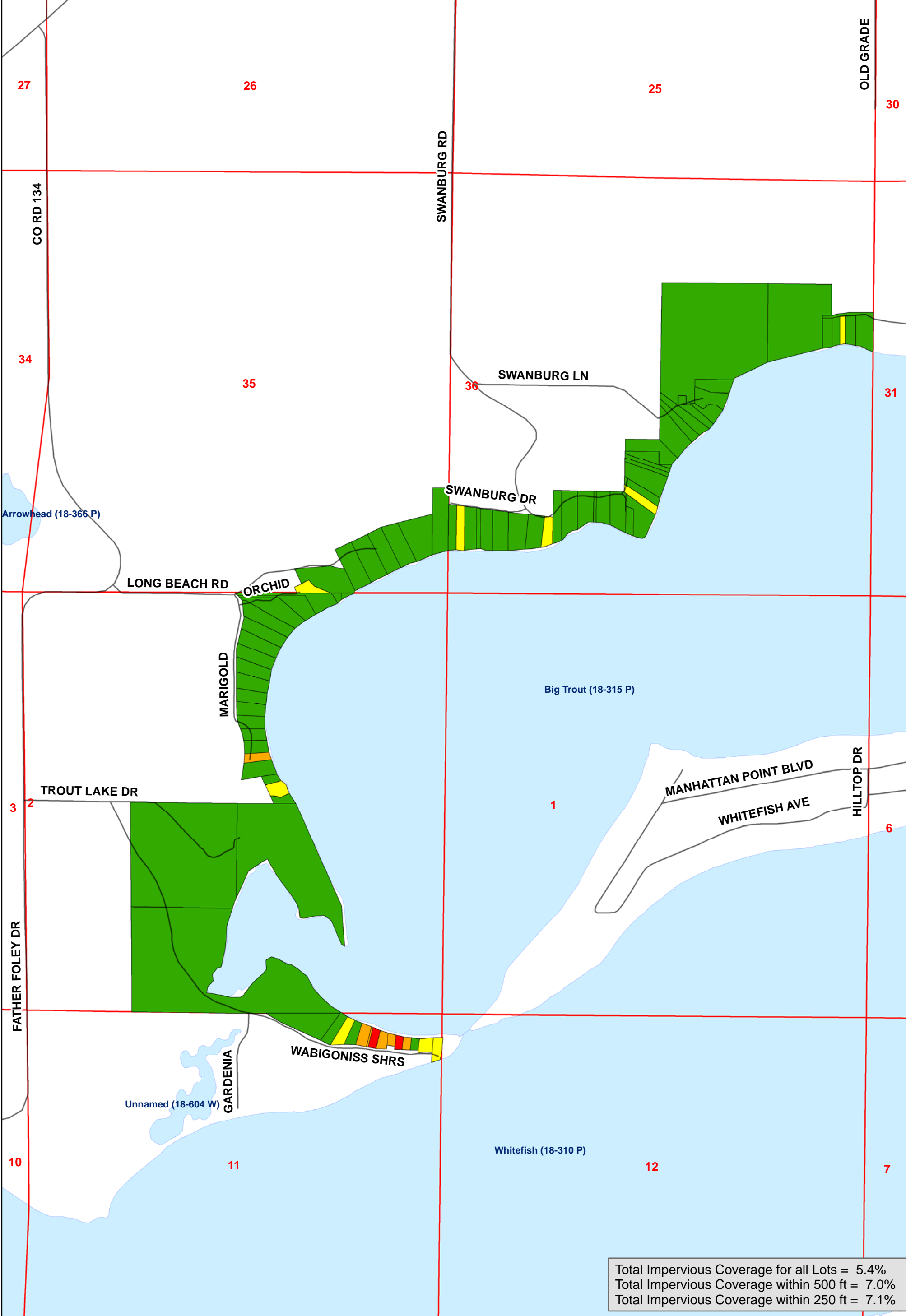
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# Lake Bertha

## Impervious % within 250 ft of Shoreline

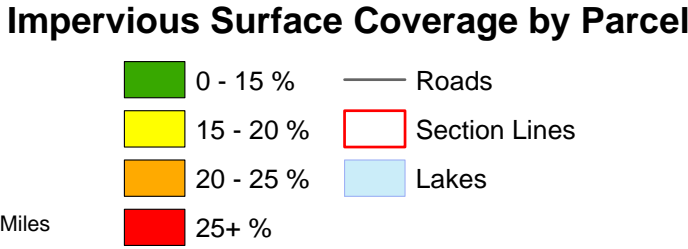
- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Roads
- Section Lines
- Lakes

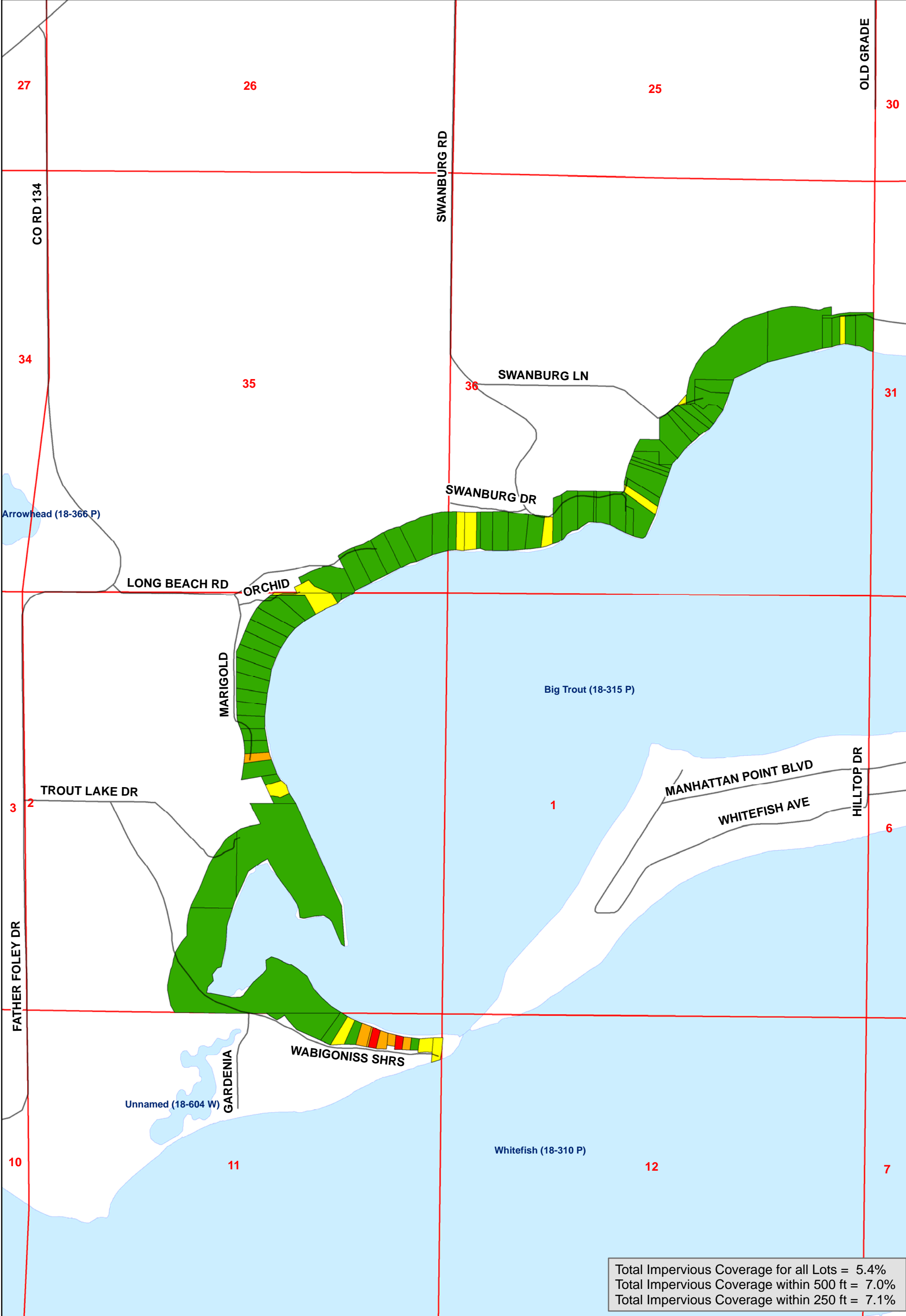


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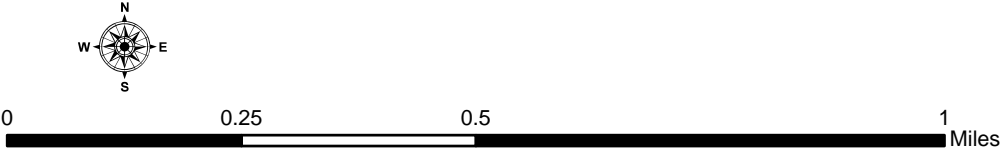
# Big Trout Lake












Total Impervious Coverage for all Lots = 5.4%  
Total Impervious Coverage within 500 ft = 7.0%  
Total Impervious Coverage within 250 ft = 7.1%

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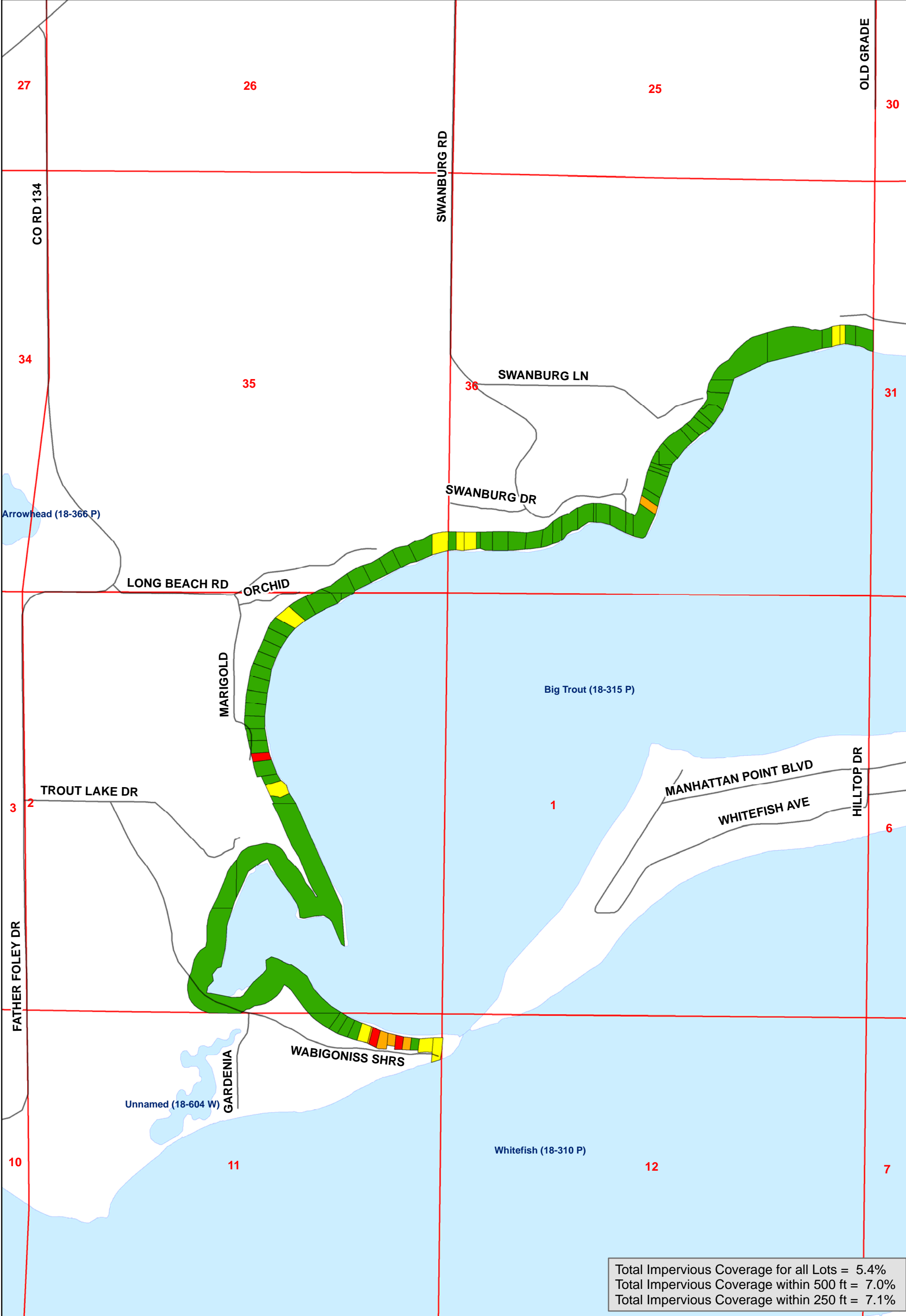


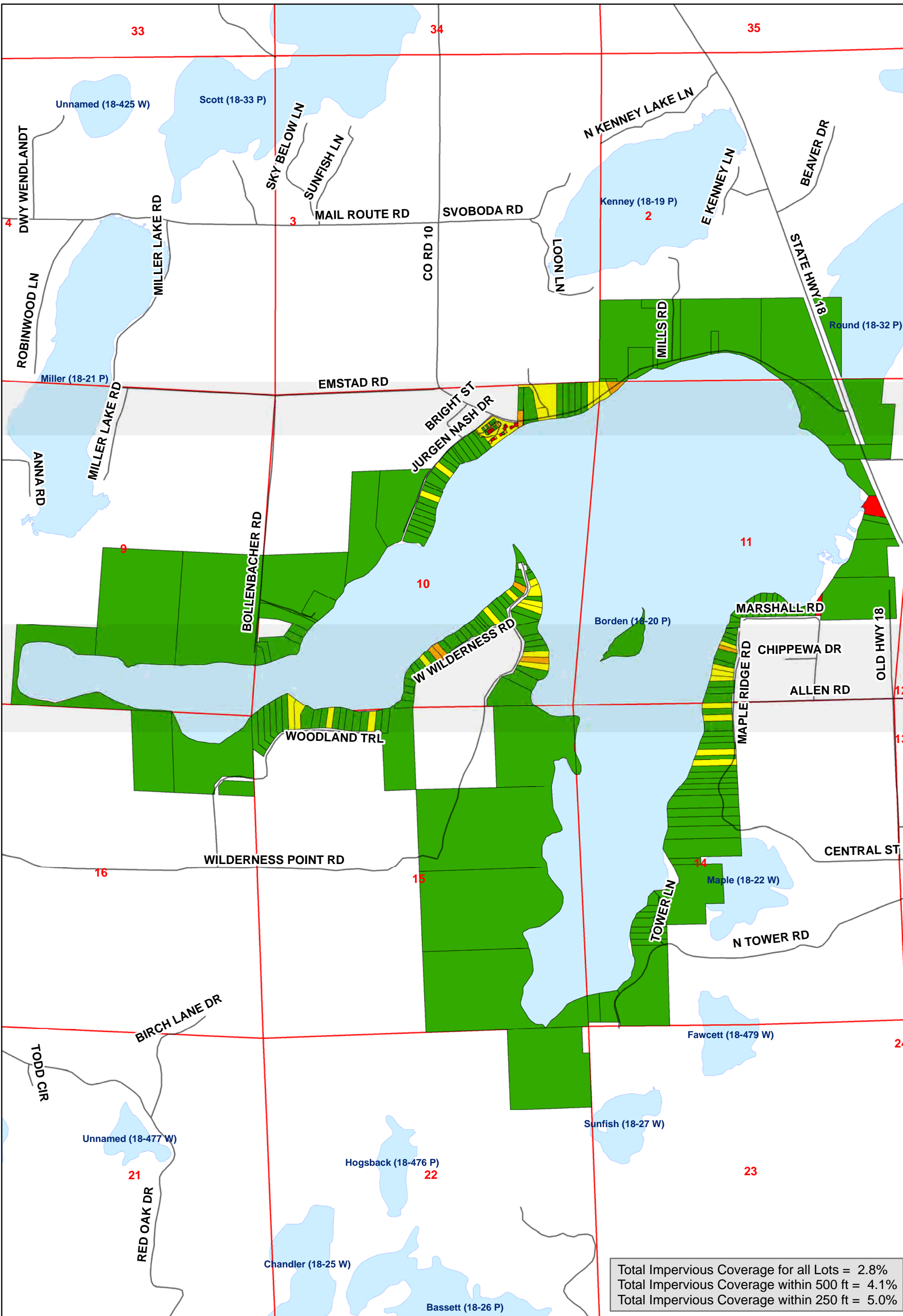
# Big Trout Lake

## Impervious % within 500 ft of Shoreline

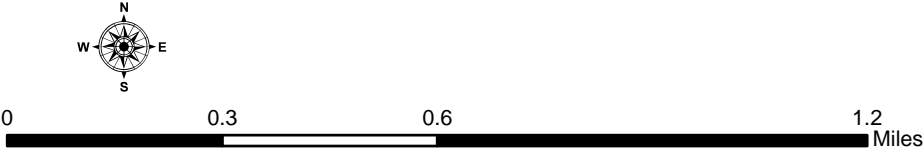
- |   |   |
|---|---|
|  0 - 15 %  |  Roads         |
|  15 - 20 % |  Section Lines |
|  20 - 25 % |  Lakes         |
|  25+ %     |   |





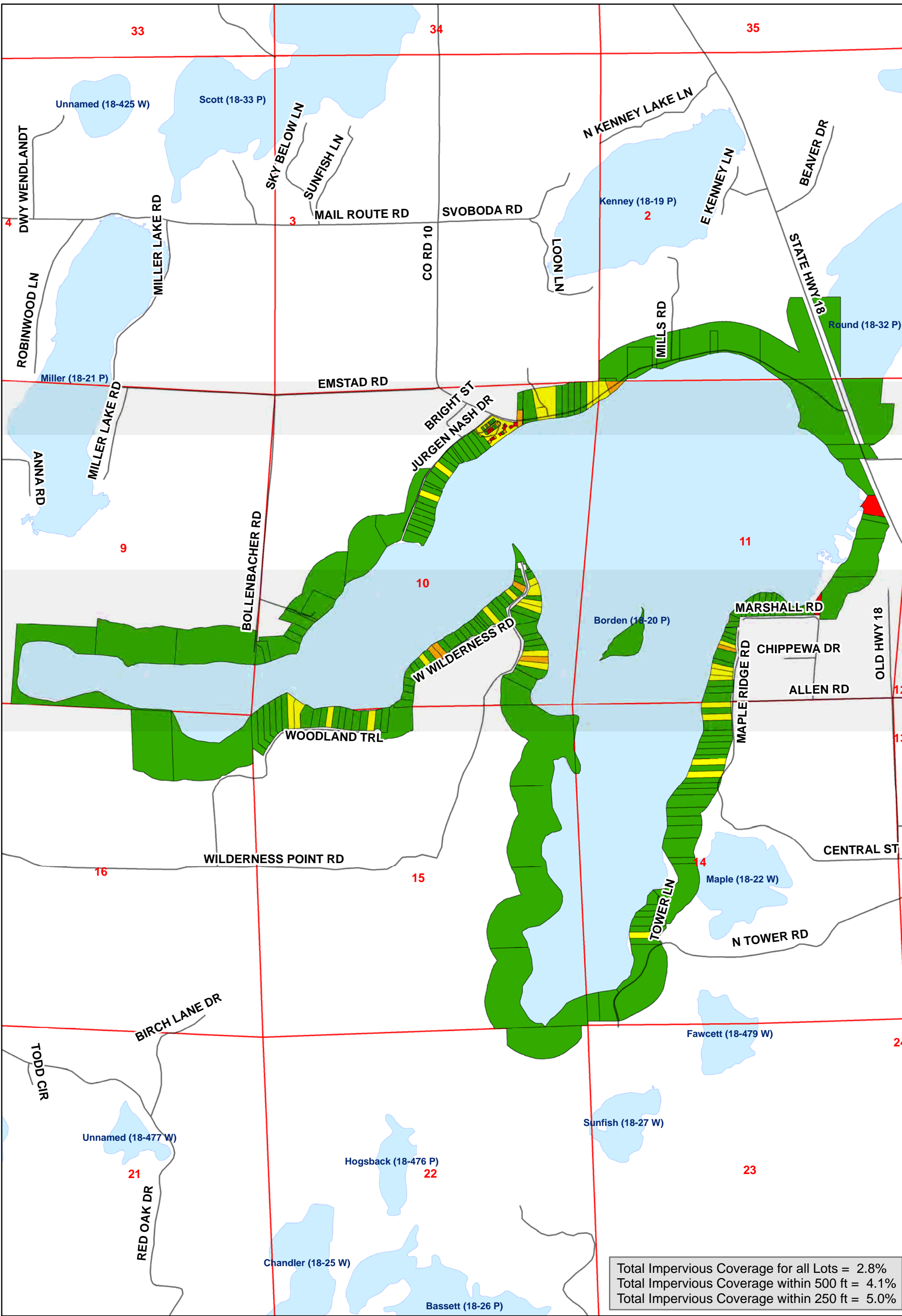


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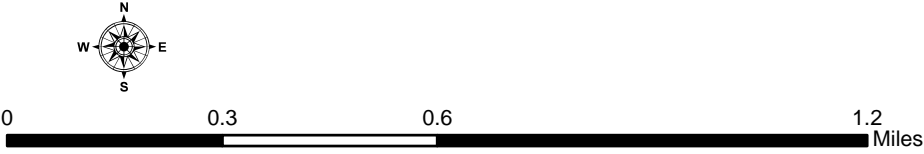


### Impervious Surface Coverage by Parcel

- 0 - 15 %
  - 15 - 20 %
  - 20 - 25 %
  - 25+ %
- Roads
  - Section Lines
  - Lakes



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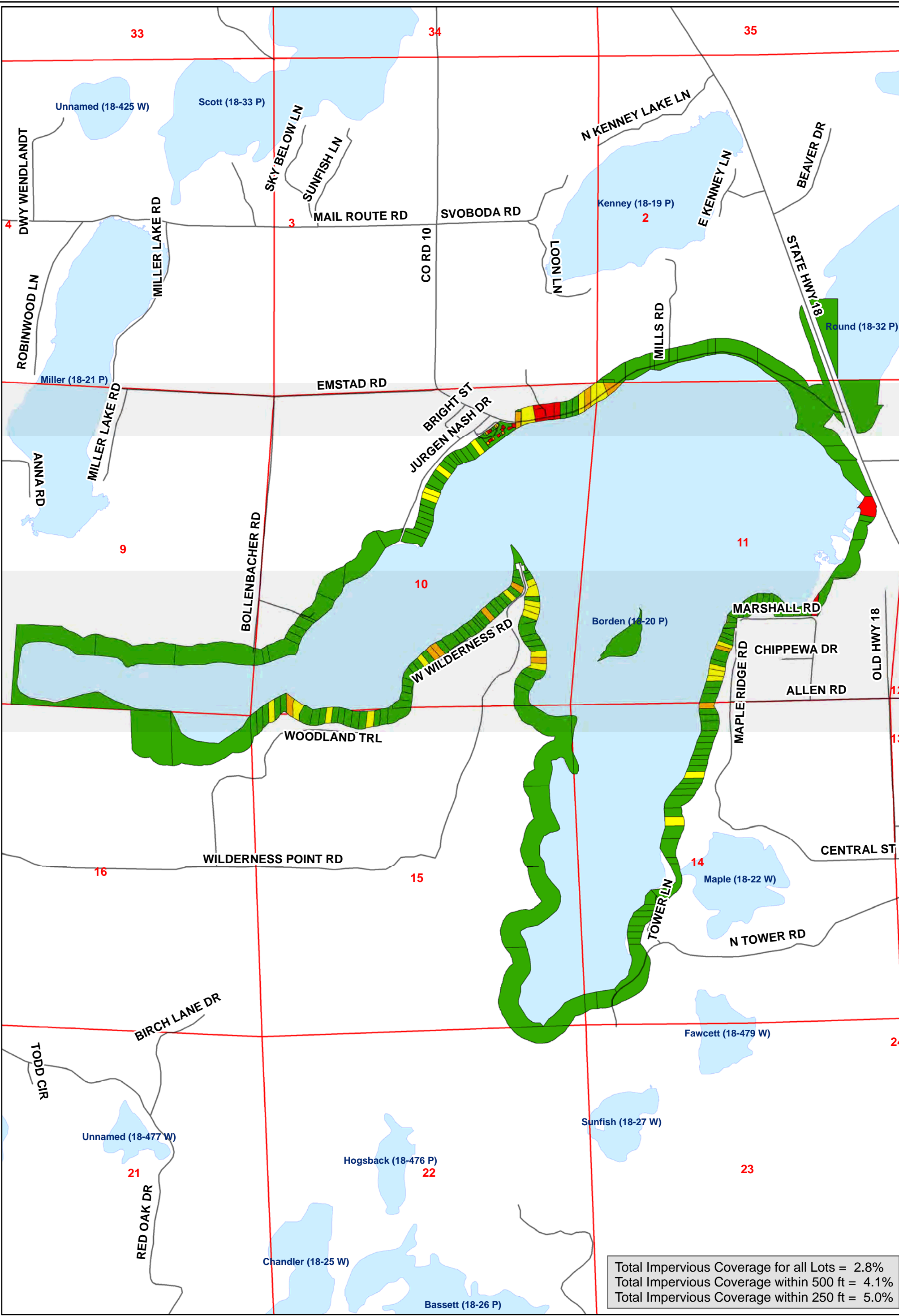


# Borden Lake

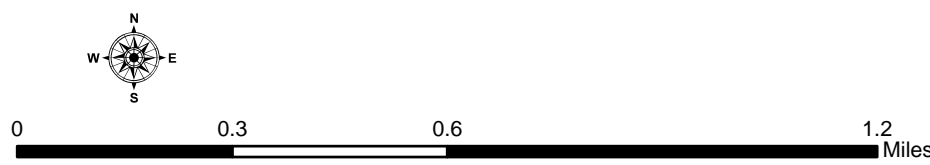
## Impervious % within 500 ft of Shoreline

- 0 - 15 %
  - 15 - 20 %
  - 20 - 25 %
  - 25+ %
- Roads
  - Section Lines
  - Lakes





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# Borden Lake

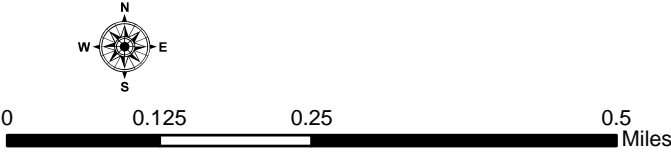
## Impervious % within 250 ft of Shoreline

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Roads
- Section Lines
- Lakes





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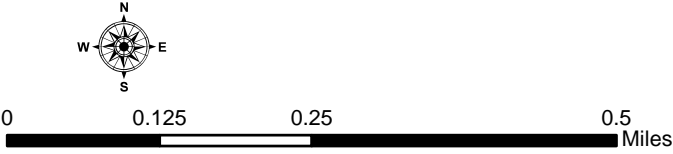


# Lake Hubert

## Impervious Surface Coverage by Parcel



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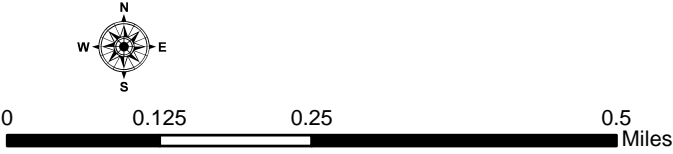
# Lake Hubert

## Impervious % within 500 ft of Shoreline

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Roads
- Section Lines
- Lakes

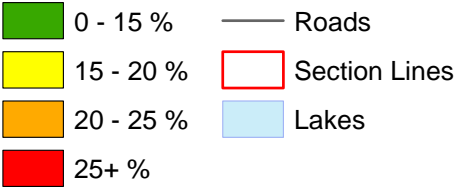


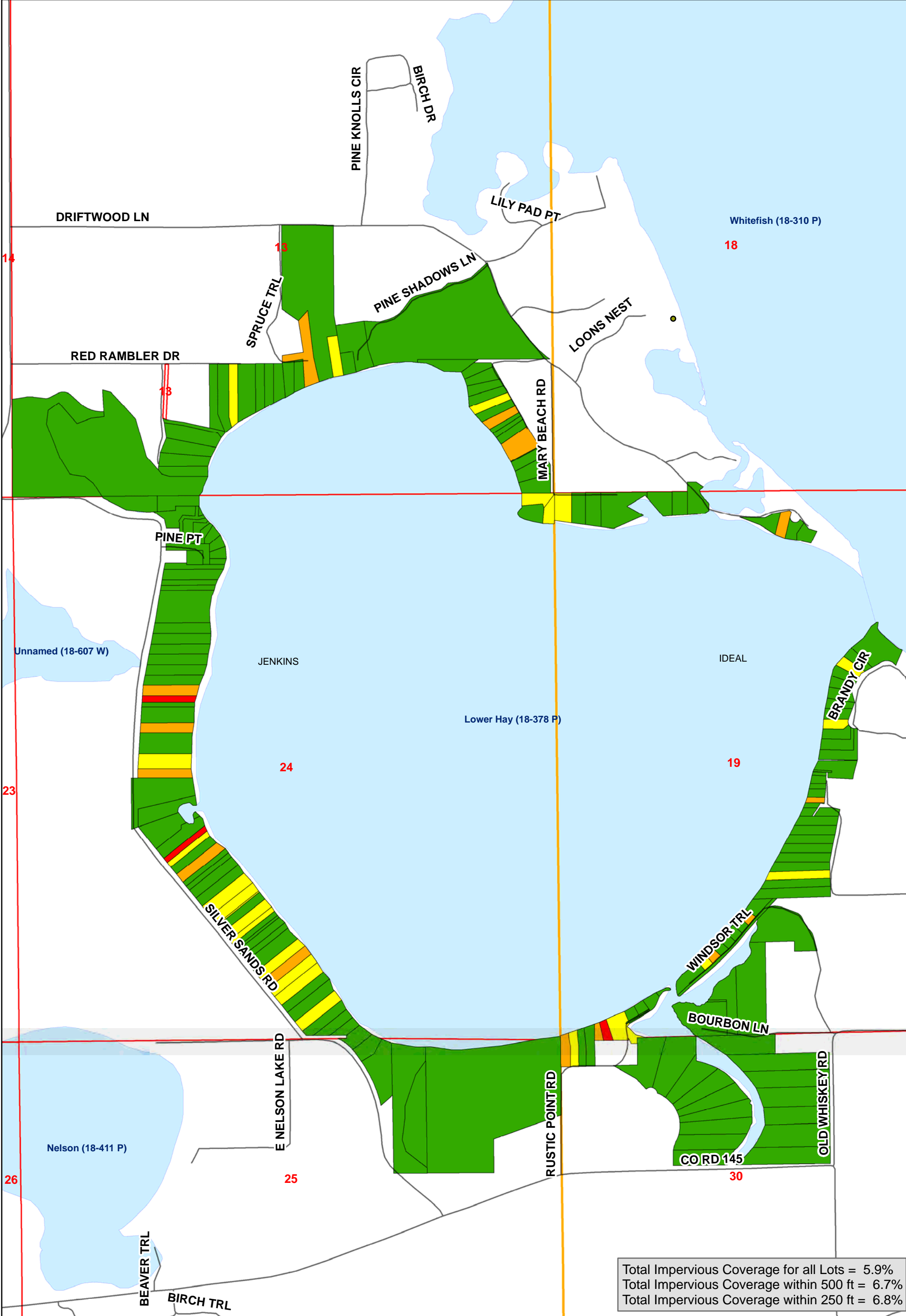
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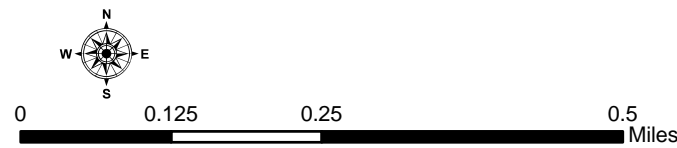
# Lake Hubert

## Impervious % within 250 ft of Shoreline





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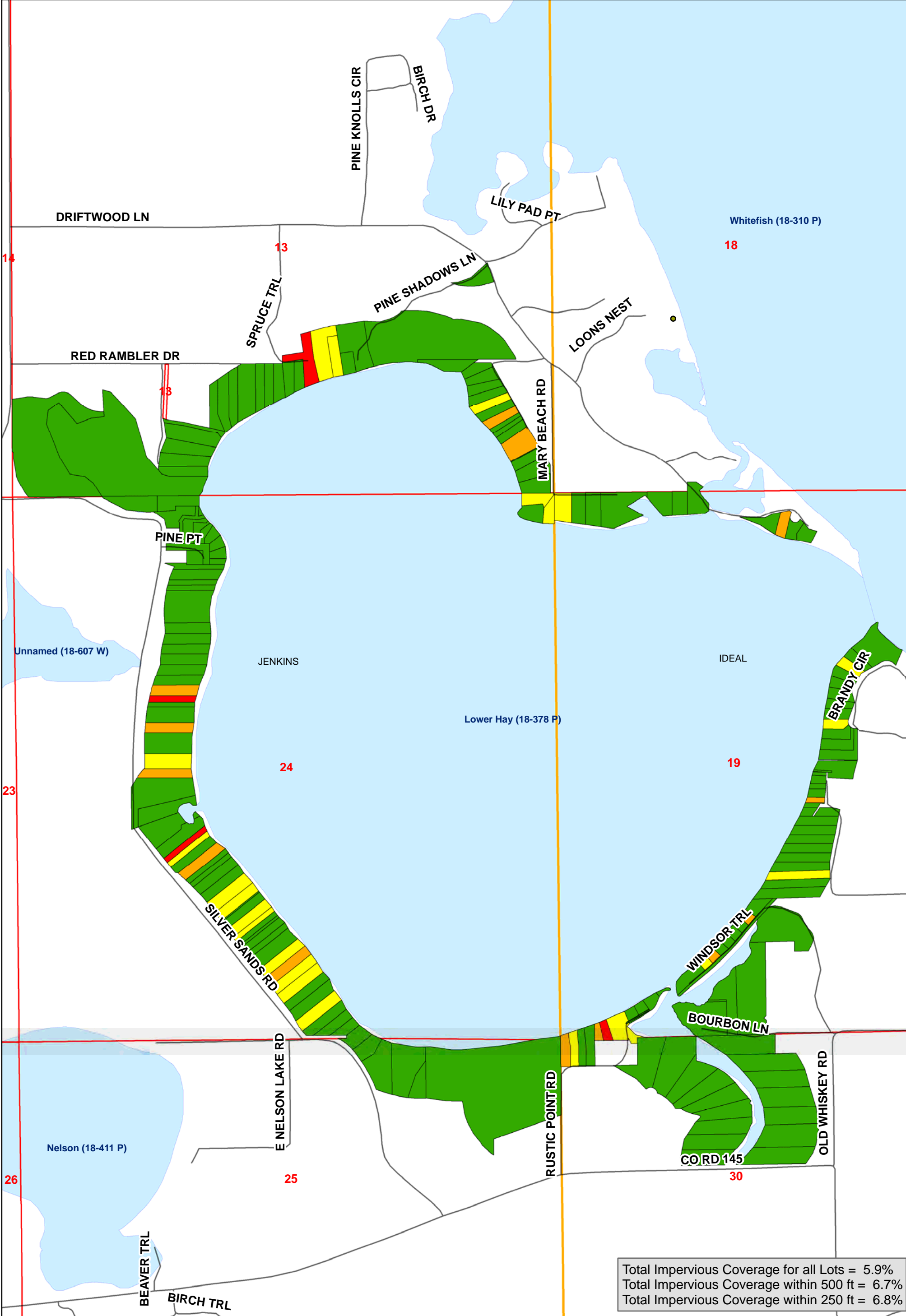


# Lower Hay Lake

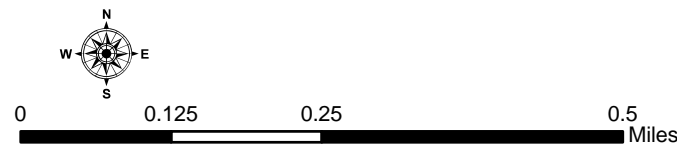
## Impervious Surface Coverage by Parcel

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Section Lines
- Roads
- Lakes



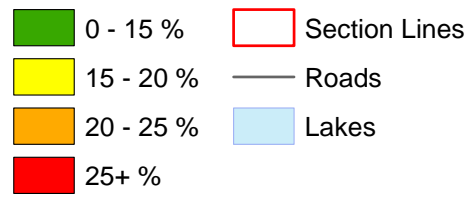


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# Lower Hay Lake

## Impervious % within 500 ft of Shoreline





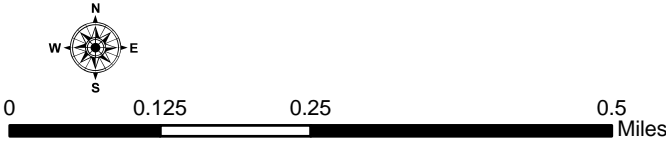
Total Impervious Coverage for all Lots = 5.9%  
Total Impervious Coverage within 500 ft = 6.7%  
Total Impervious Coverage within 250 ft = 6.8%

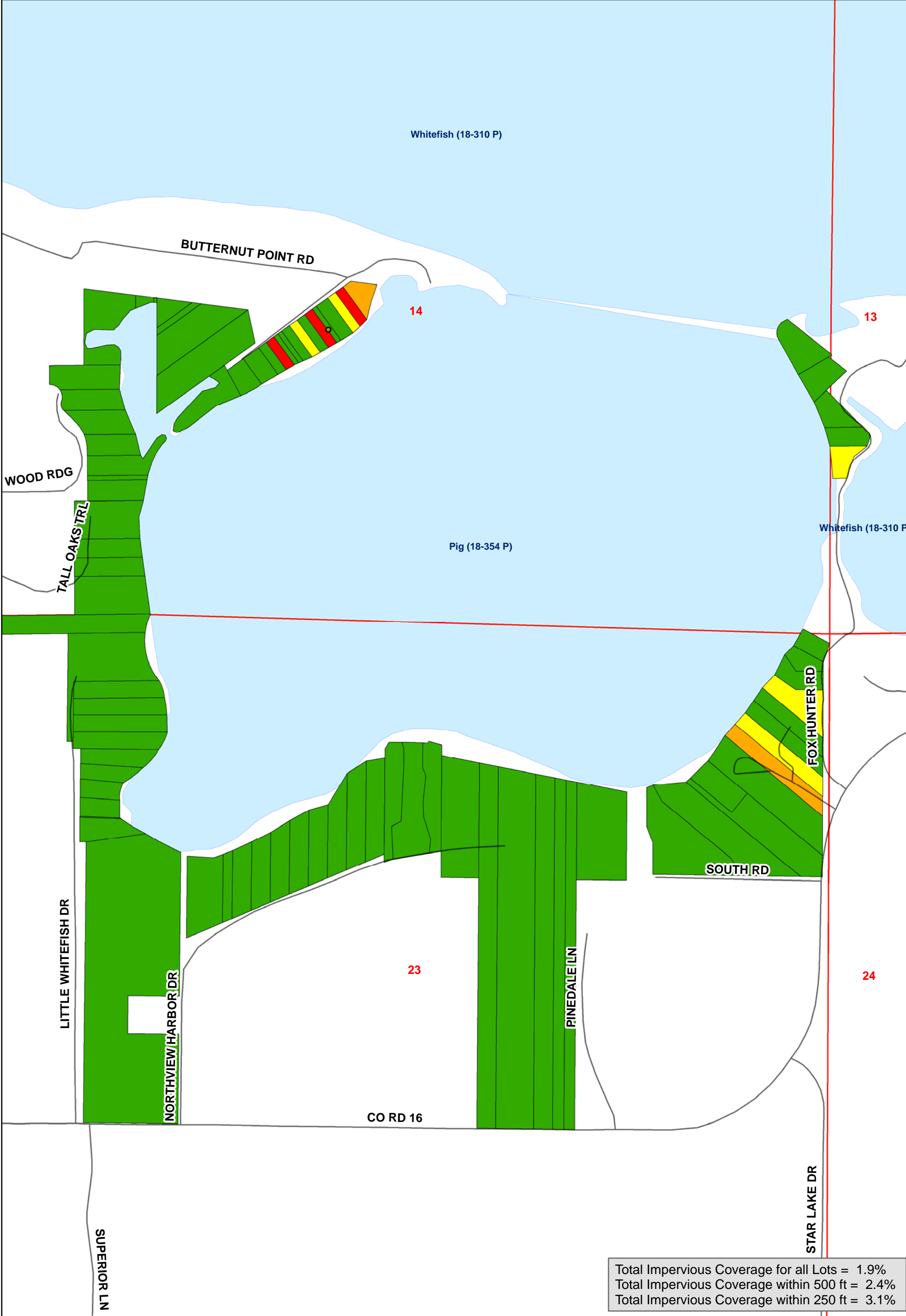
Lower Hay Lake

Impervious % within 250 ft of Shoreline

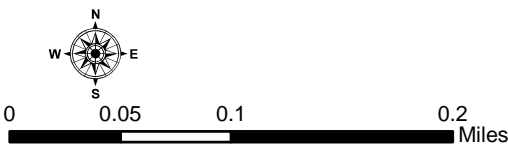
- |           |               |
|-----------|---------------|
| 0 - 15 %  | Section Lines |
| 15 - 20 % | Roads         |
| 20 - 25 % | Lakes         |
| 25+ %     |               |

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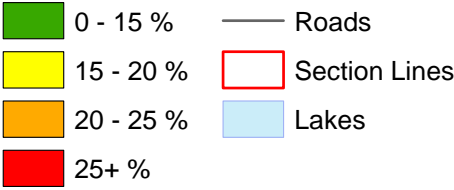


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# Pig Lake

## Impervious Surface Coverage by Parcel



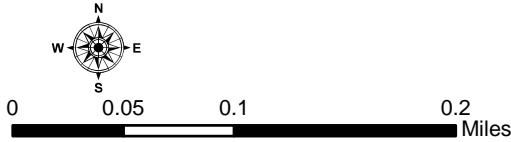


Total Impervious Coverage for all Lots = 1.9%  
Total Impervious Coverage within 500 ft = 2.4%  
Total Impervious Coverage within 250 ft = 3.1%

# Pig Lake

## Impervious % within 500 ft of Shoreline

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Roads
- Section Lines
- Lakes





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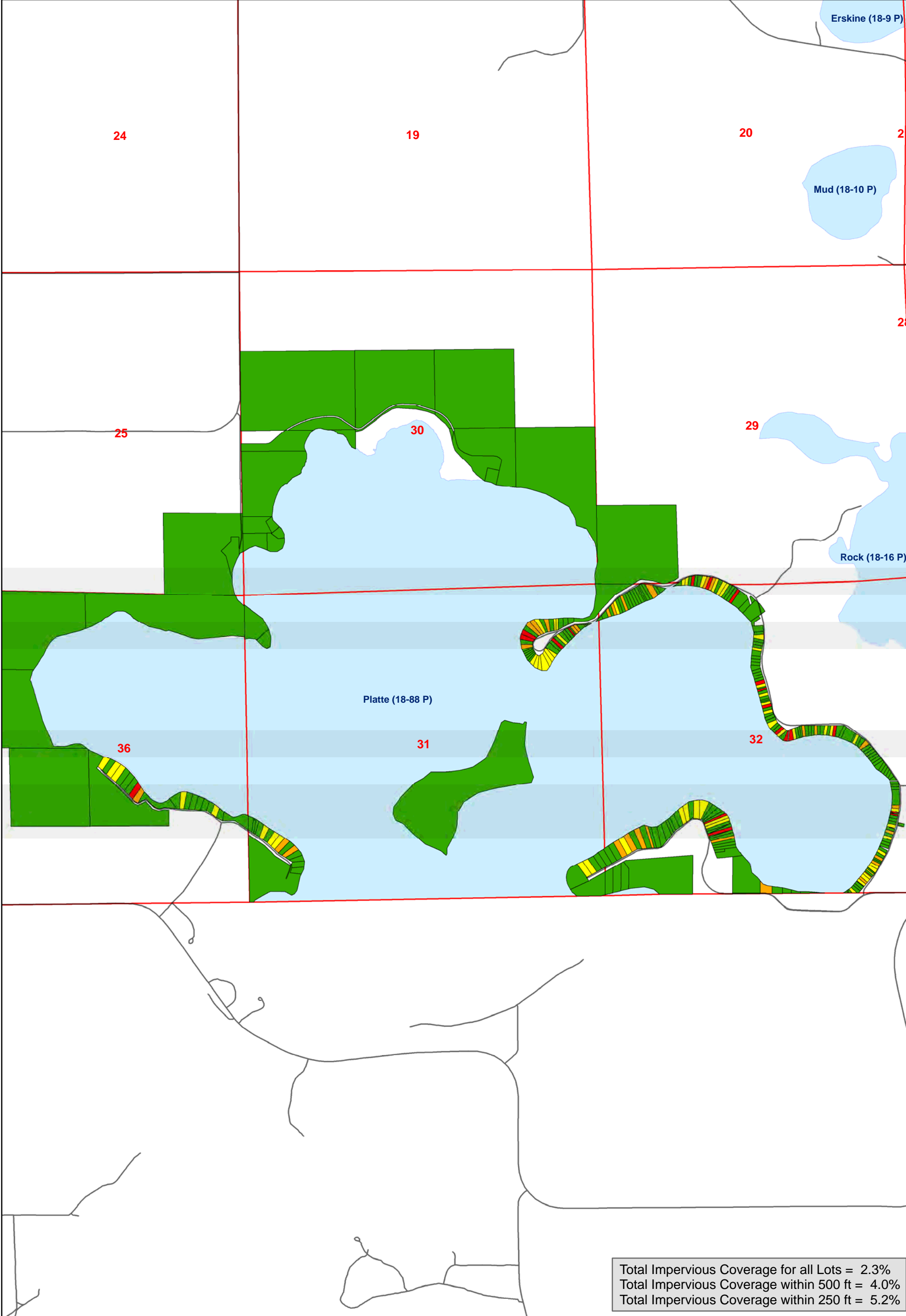
0 0.05 0.1 0.2 Miles

# Pig Lake

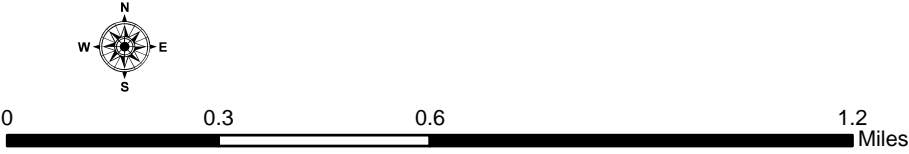
## Impervious % within 250 ft of Shoreline

- |           |               |
|-----------|---------------|
| 0 - 15 %  | Roads         |
| 15 - 20 % | Section Lines |
| 20 - 25 % | Lakes         |
| 25+ %     |               |





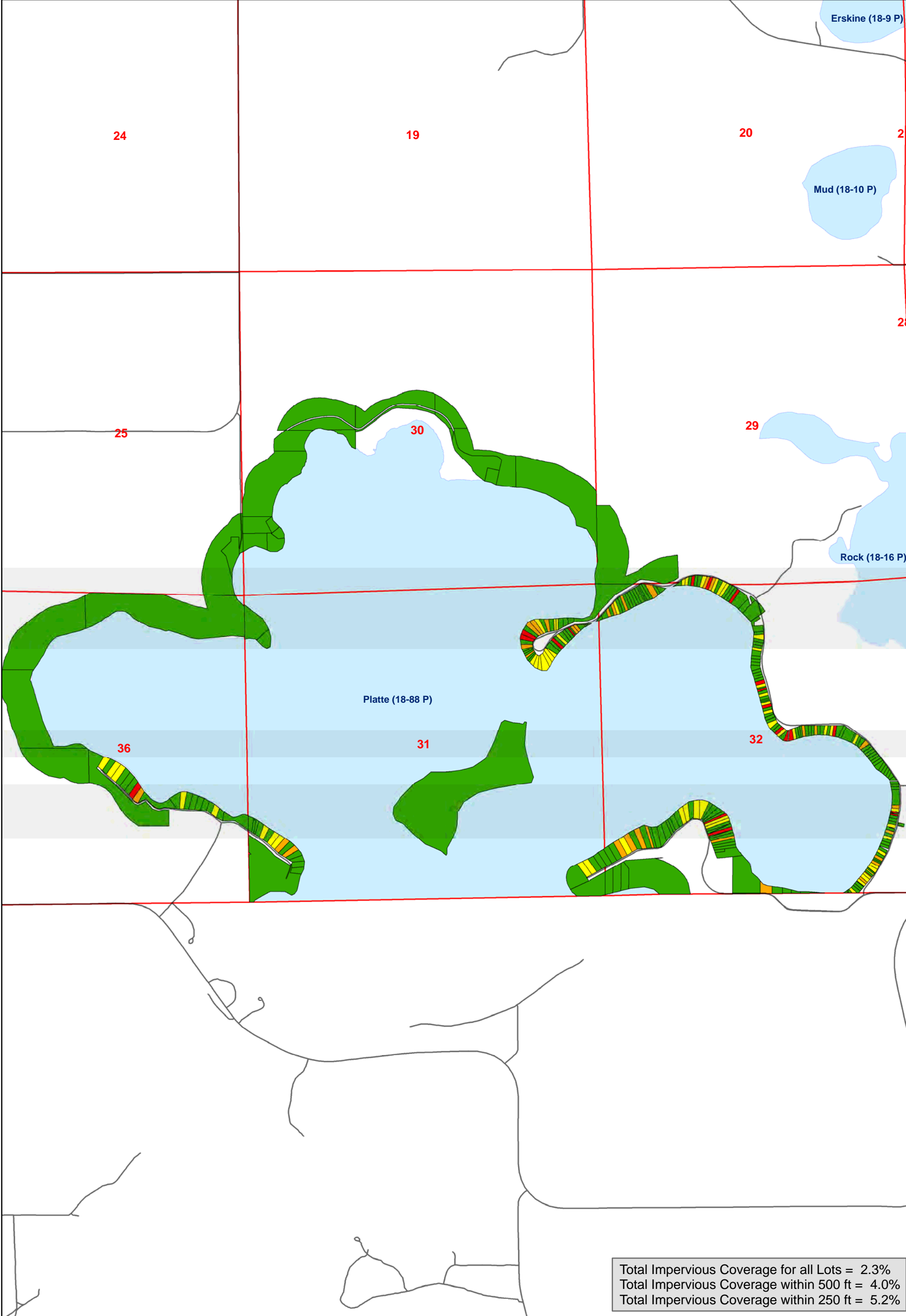
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# Platte Lake

## Impervious Surface Coverage by Parcel

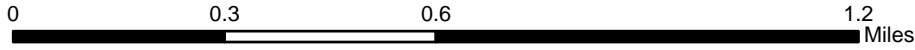
- |                       |                           |
|-----------------------|---------------------------|
| <div></div> 0 - 15 %  | <div></div> Roads         |
| <div></div> 15 - 20 % | <div></div> Section Lines |
| <div></div> 20 - 25 % | <div></div> Lakes         |
| <div></div> 25+ %     |                           |



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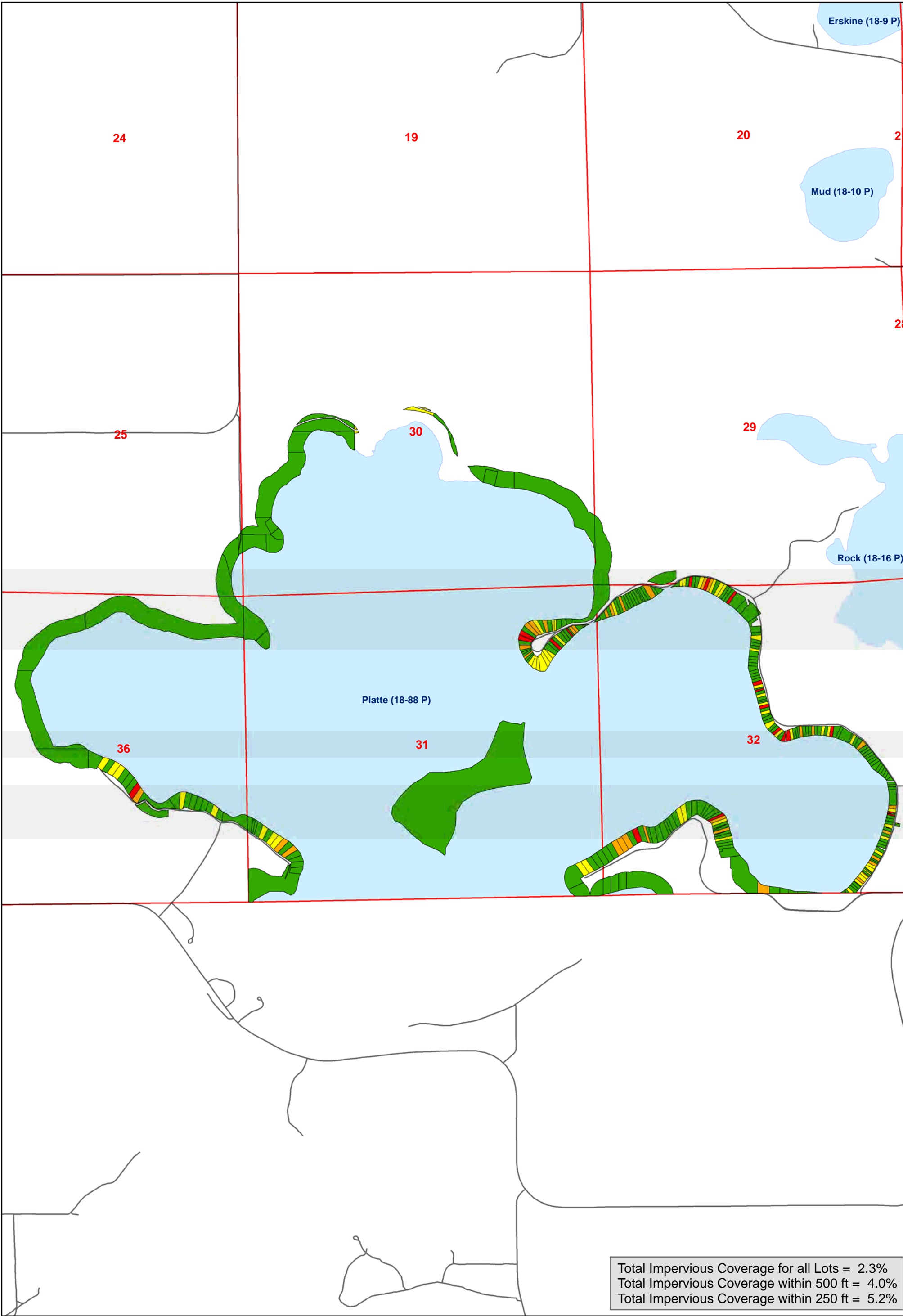
Environmental Services



# Platte Lake

## Impervious % within 500 ft of Shoreline

- |           |                 |
|-----------|-----------------|
| 0 - 15 %  | — Roads         |
| 15 - 20 % | □ Section Lines |
| 20 - 25 % | □ Lakes         |
| 25+ %     |                 |



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Environmental Services

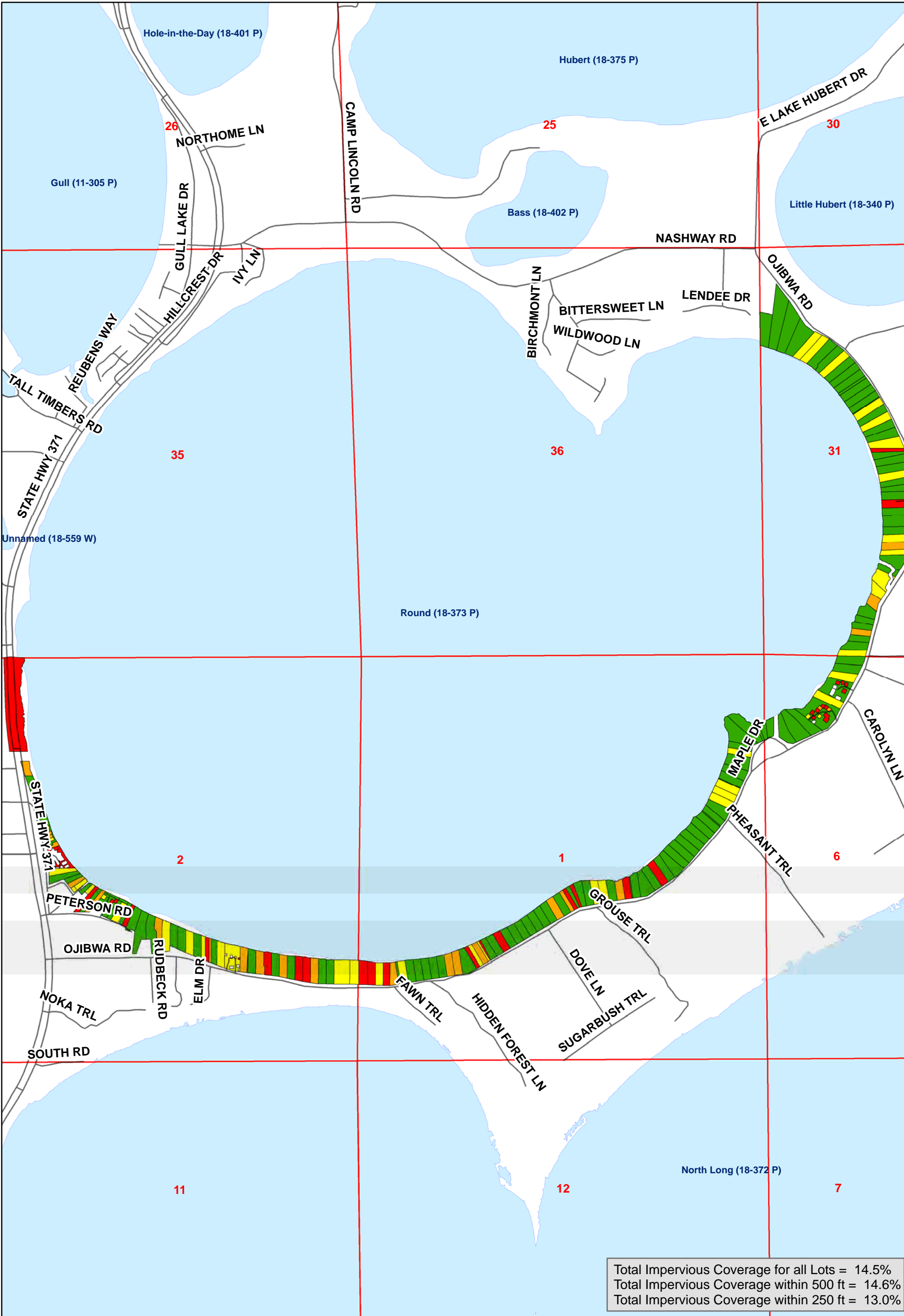


0 0.3 0.6 1.2 Miles

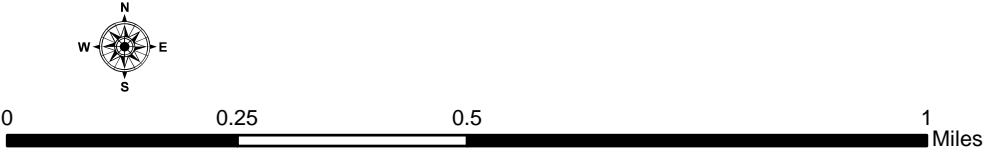
# Platte Lake

## Impervious % within 250 ft of Shoreline

- |           |                 |
|-----------|-----------------|
| 0 - 15 %  | — Roads         |
| 15 - 20 % | □ Section Lines |
| 20 - 25 % | □ Lakes         |
| 25+ %     |                 |

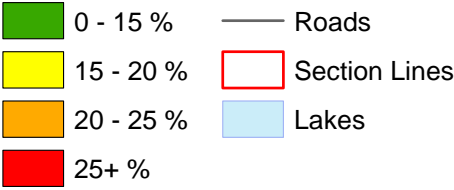


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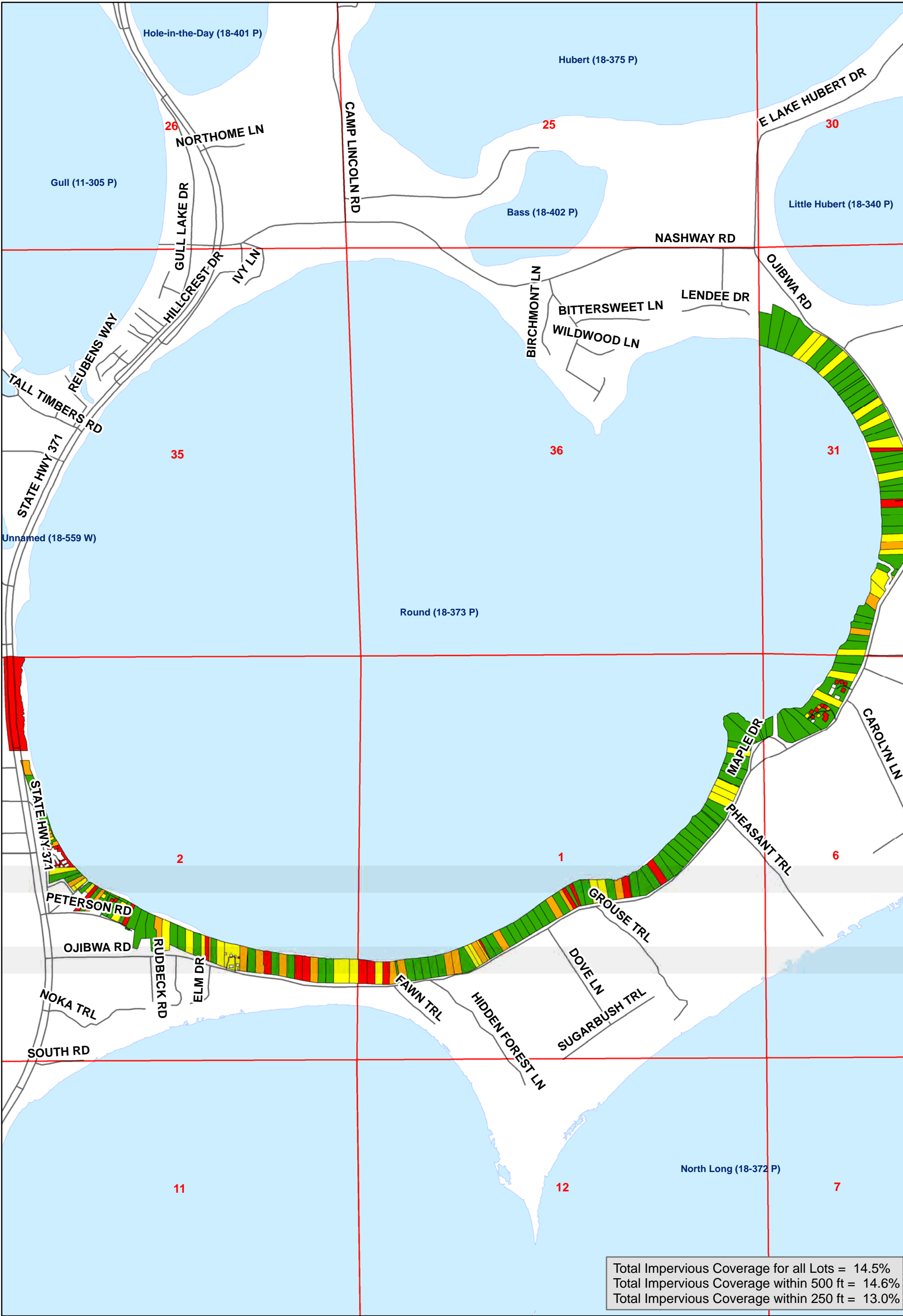


# Round Lake

## Impervious Surface Coverage by Parcel

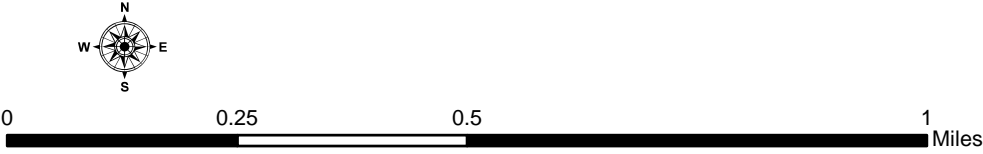






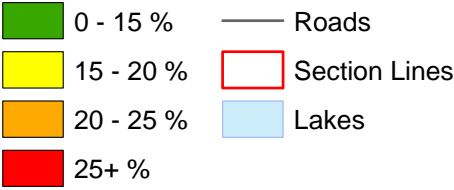


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# Round Lake

## Impervious % within 250 ft of Shoreline



Whitefish (18-310 P)

DWY BEACON SHORES RESORT

HILLCREST HTS

SILVER PEAK RD

RONA SHORES CIR

LYNN BOYD WAY

13

DWY - GOLDEN HARBOR MH PARK

DWY - PEACEFUL HARBOR MH PARK

MILINDA SHORES RD

Rush (18-311 P)

18

HARBOR TRL

HARBOR LN

CAMELIA

Total Impervious Coverage for all Lots = 13.7%  
Total Impervious Coverage within 500 ft = 13.7%  
Total Impervious Coverage within 250 ft = 12.7%

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Environmental Services

CROW WING COUNTY  
BRANDER, MINNESOTA 56031



0 250 500 1,000 Feet

# Rush Lake

## Impervious % within 500 ft of Shoreline

- |           |                 |
|-----------|-----------------|
| 0 - 15 %  | — Roads         |
| 15 - 20 % | □ Section Lines |
| 20 - 25 % | ■ Lakes         |
| 25+ %     |                 |

Whitefish (18-310 P)

DWY BEACON SHORES RESORT

HILLCREST HTS

SILVER PEAK RD

DWY - PEACEFUL HARBOR MH PARK

MILINDA SHORES RD

DWY - GOLDEN HARBOR MH PARK

LYNN BOYD WAY

RONA SHORES CIR

Rush (18-311 P)

HARBOR LN

CAMELIA

HARBOR TRL

13

18

Total Impervious Coverage for all Lots = 13.7%  
Total Impervious Coverage within 500 ft = 13.7%  
Total Impervious Coverage within 250 ft = 12.7%

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Environmental Services

CROW WING COUNTY  
BRAINERD, MINNESOTA 56301



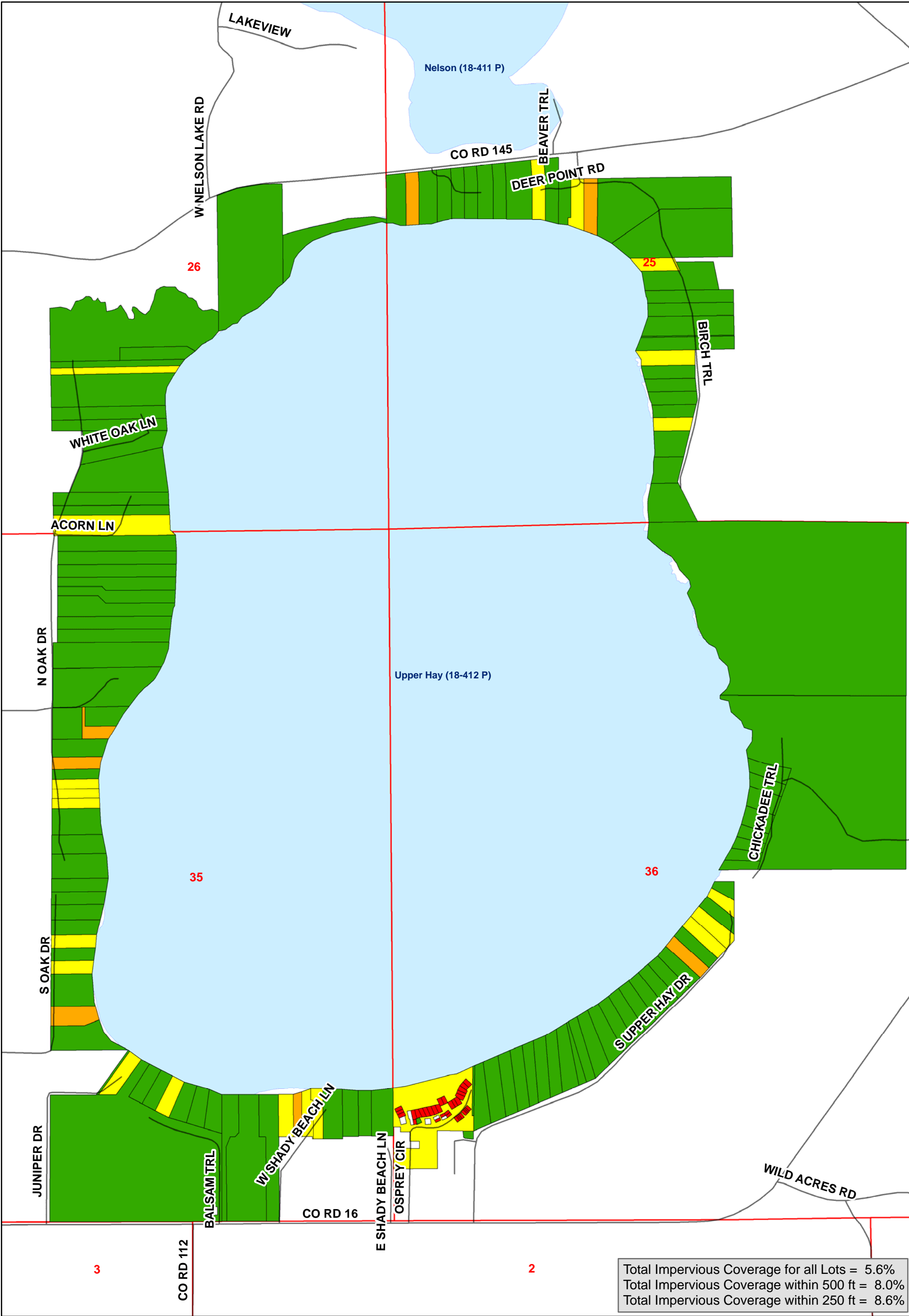
0 250 500 1,000 Feet

# Rush Lake

## Impervious % within 250 ft of Shoreline

- |           |                 |
|-----------|-----------------|
| 0 - 15 %  | — Roads         |
| 15 - 20 % | □ Section Lines |
| 20 - 25 % | ■ Lakes         |
| 25+ %     |                 |

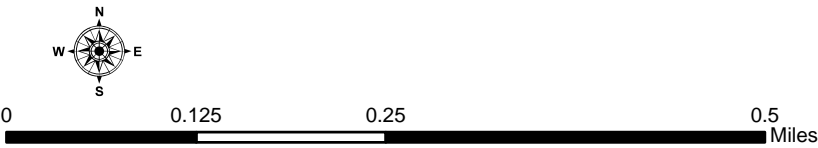




Total Impervious Coverage for all Lots = 5.6%  
Total Impervious Coverage within 500 ft = 8.0%  
Total Impervious Coverage within 250 ft = 8.6%

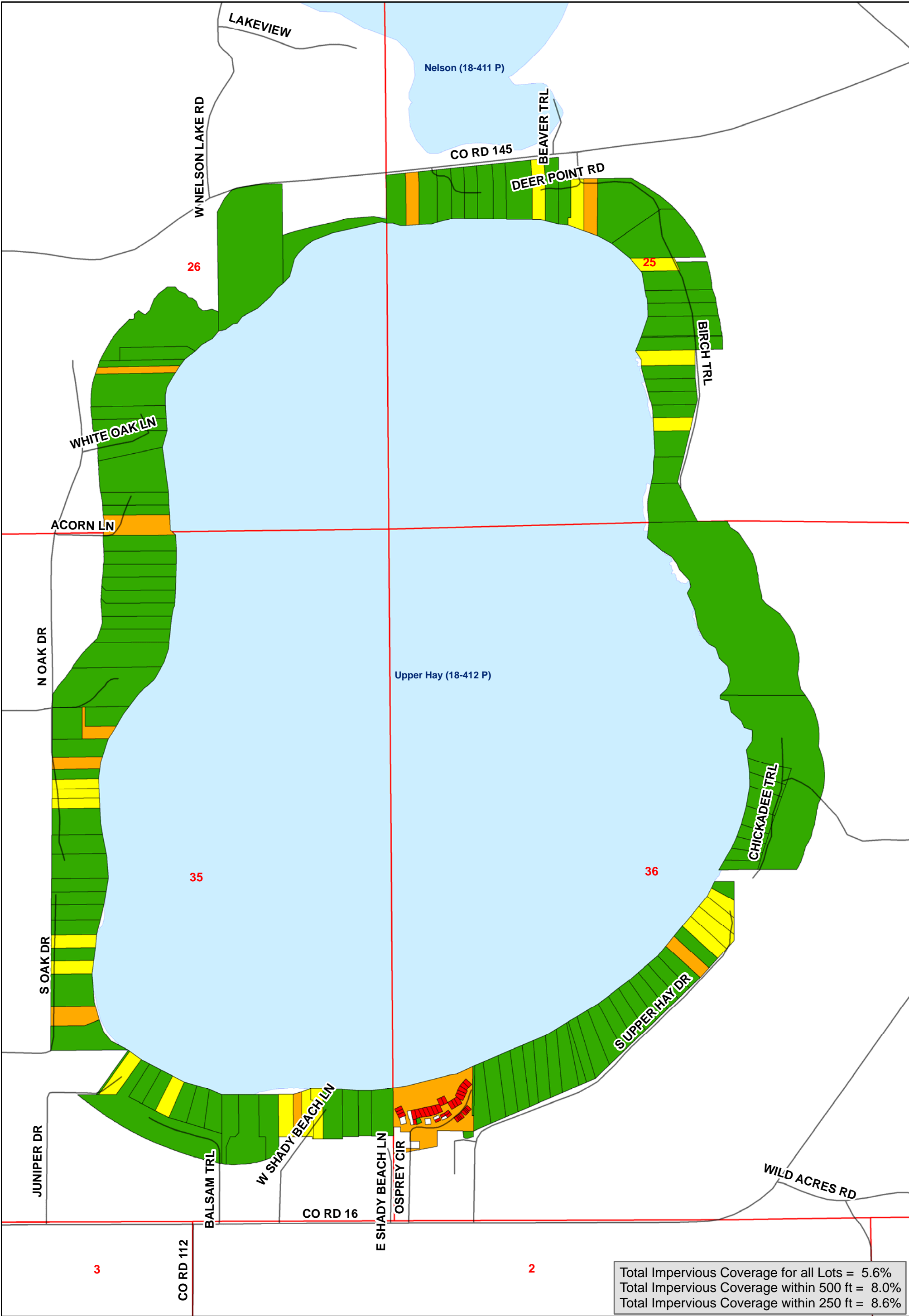
# Upper Hay Lake

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## Impervious Surface Coverage by Parcel

- |           |               |
|-----------|---------------|
| 0 - 15 %  | Section Lines |
| 15 - 20 % | Roads         |
| 20 - 25 % | Lakes         |
| 25+ %     |               |



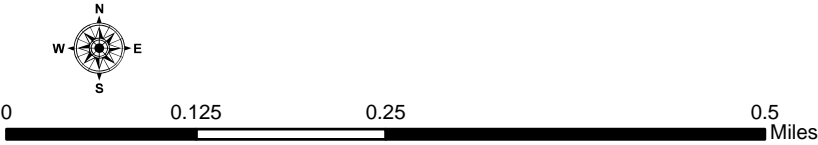
Total Impervious Coverage for all Lots = 5.6%  
Total Impervious Coverage within 500 ft = 8.0%  
Total Impervious Coverage within 250 ft = 8.6%

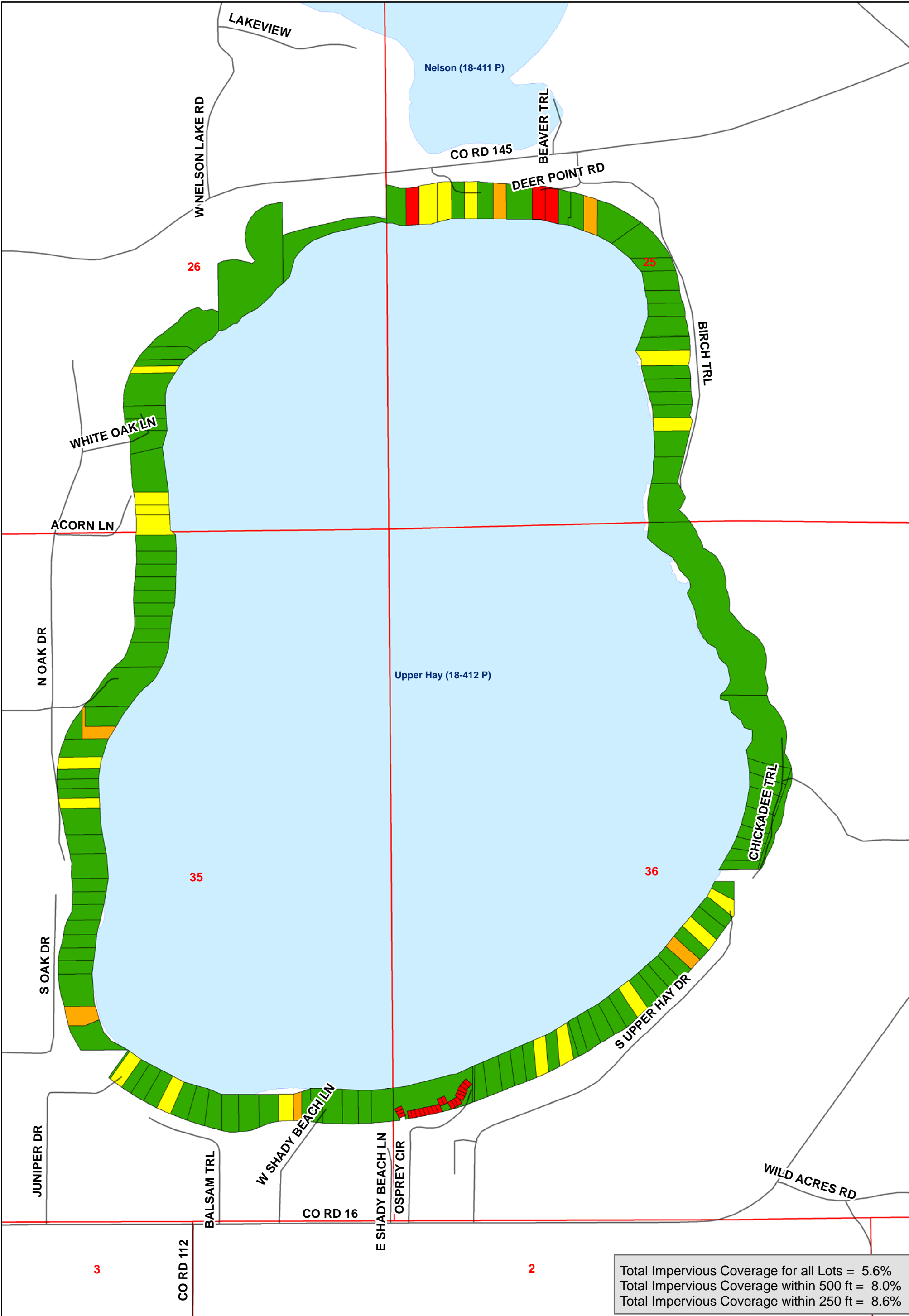
# Upper Hay Lake

## Impervious % within 500 ft of Shoreline

- |                       |                           |
|-----------------------|---------------------------|
| <div></div> 0 - 15 %  | <div></div> Section Lines |
| <div></div> 15 - 20 % | <div></div> Roads         |
| <div></div> 20 - 25 % | <div></div> Lakes         |
| <div></div> 25+ %     |                           |

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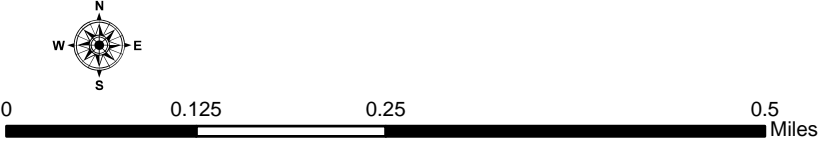
Total Impervious Coverage for all Lots = 5.6%  
Total Impervious Coverage within 500 ft = 8.0%  
Total Impervious Coverage within 250 ft = 8.6%

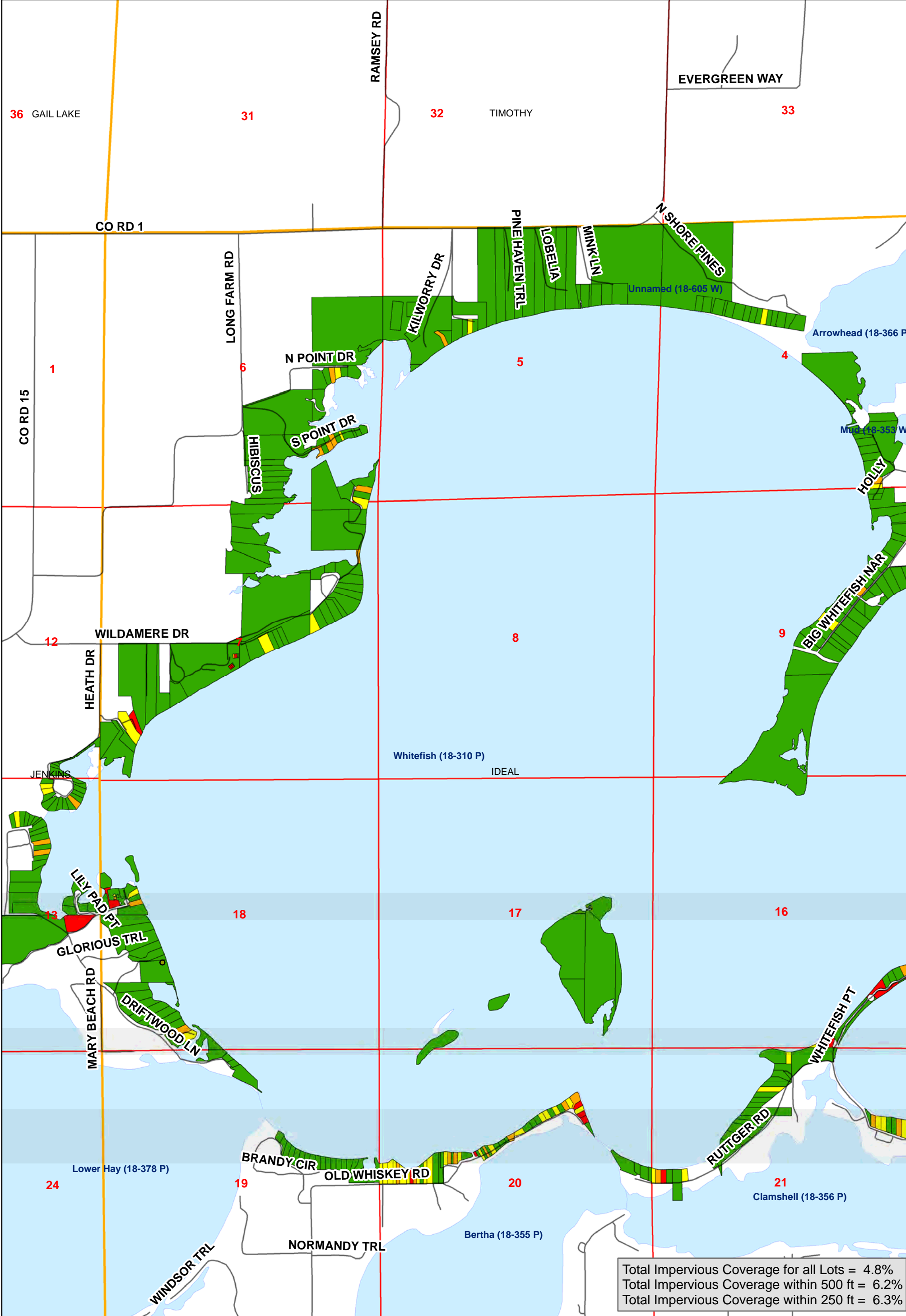
# Upper Hay Lake

## Impervious % within 250 ft of Shoreline

- |                       |                           |
|-----------------------|---------------------------|
| <div></div> 0 - 15 %  | <div></div> Section Lines |
| <div></div> 15 - 20 % | <div></div> Roads         |
| <div></div> 20 - 25 % | <div></div> Lakes         |
| <div></div> 25+ %     |                           |

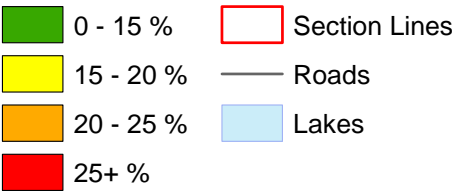
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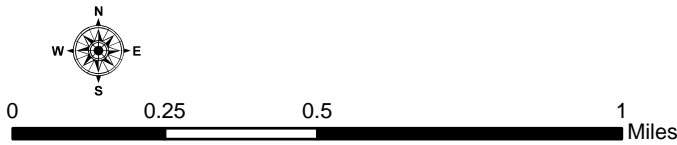


Whitefish Lake (West)

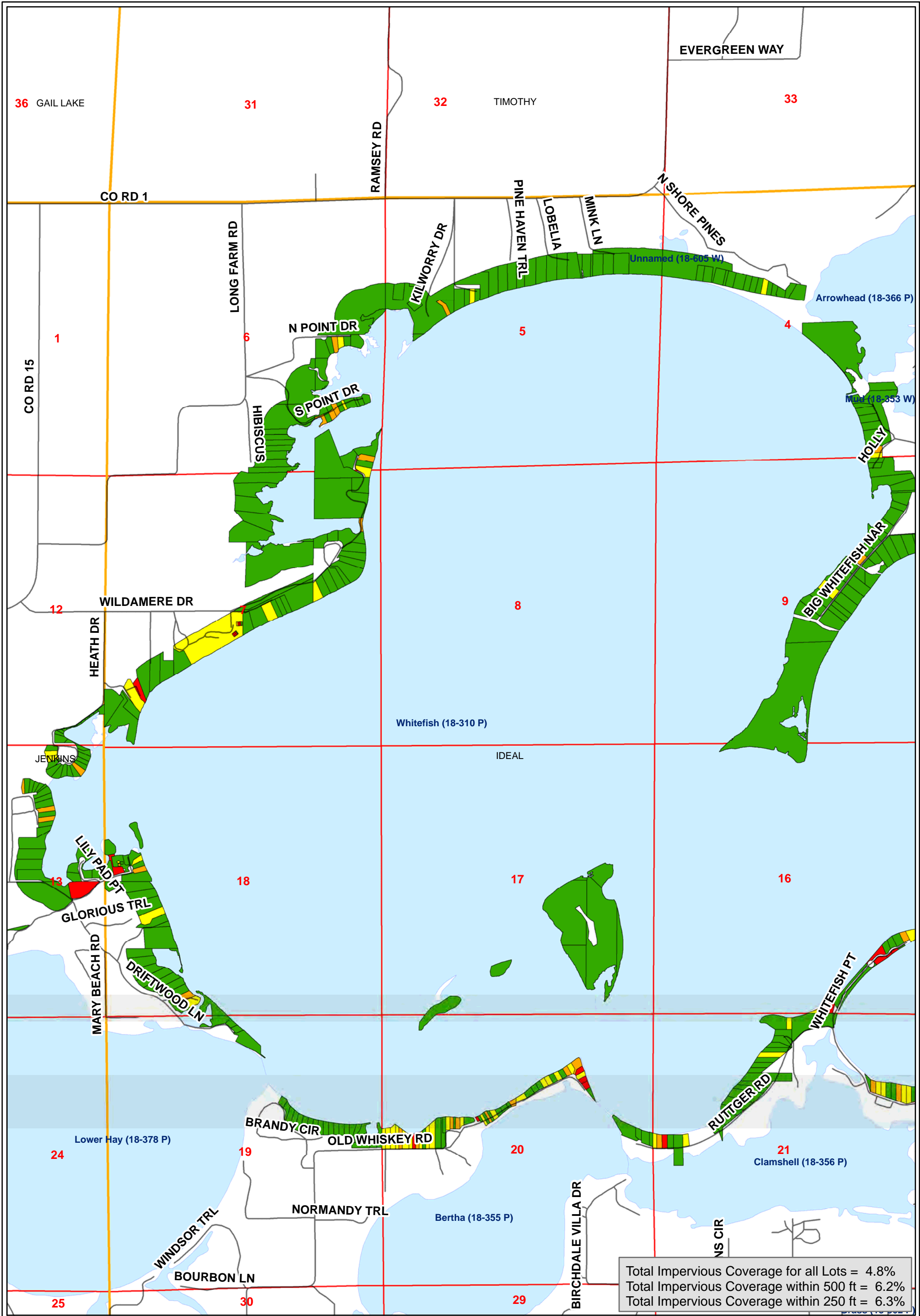
Impervious Surface Coverage by Parcel



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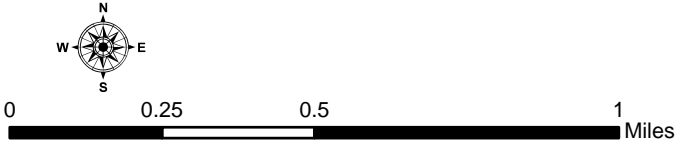


Whitefish Lake (West)

Impervious % within 500 ft of Shoreline

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Section Lines
- Roads
- Lakes

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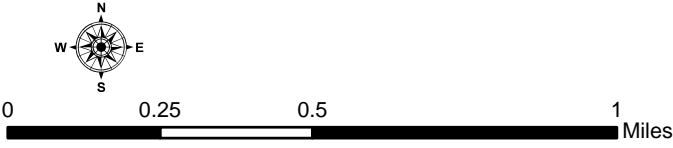


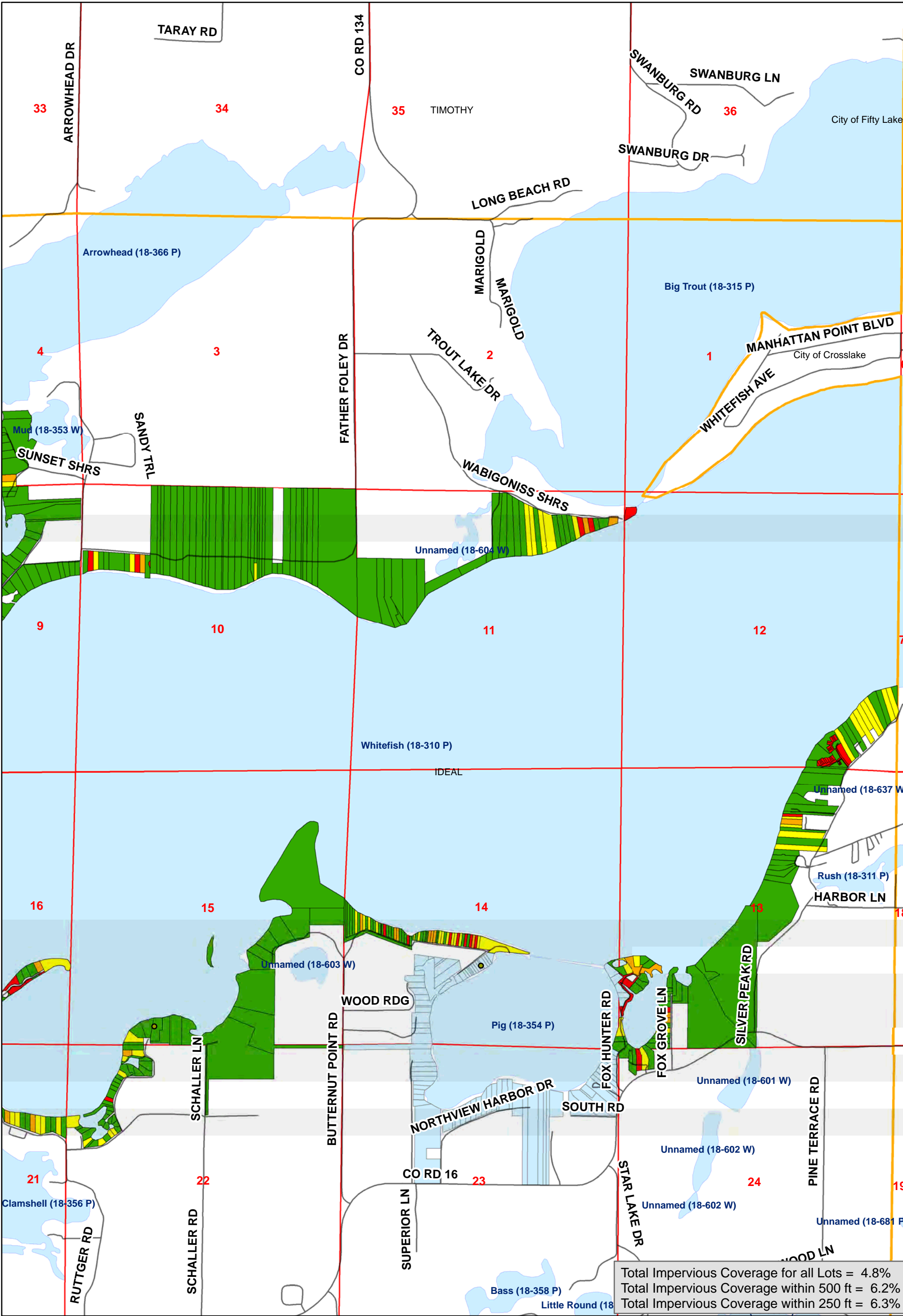
Whitefish Lake (West)

Impervious % within 250 ft of Shoreline

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Section Lines
- Roads
- Lakes

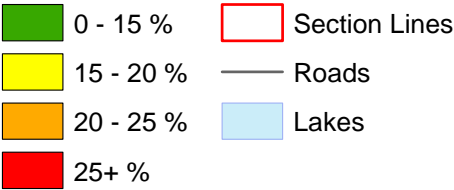
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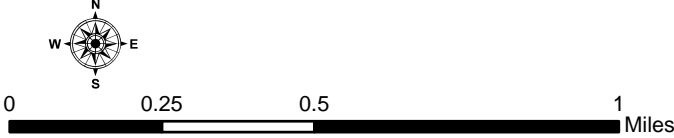


Whitefish Lake (East)

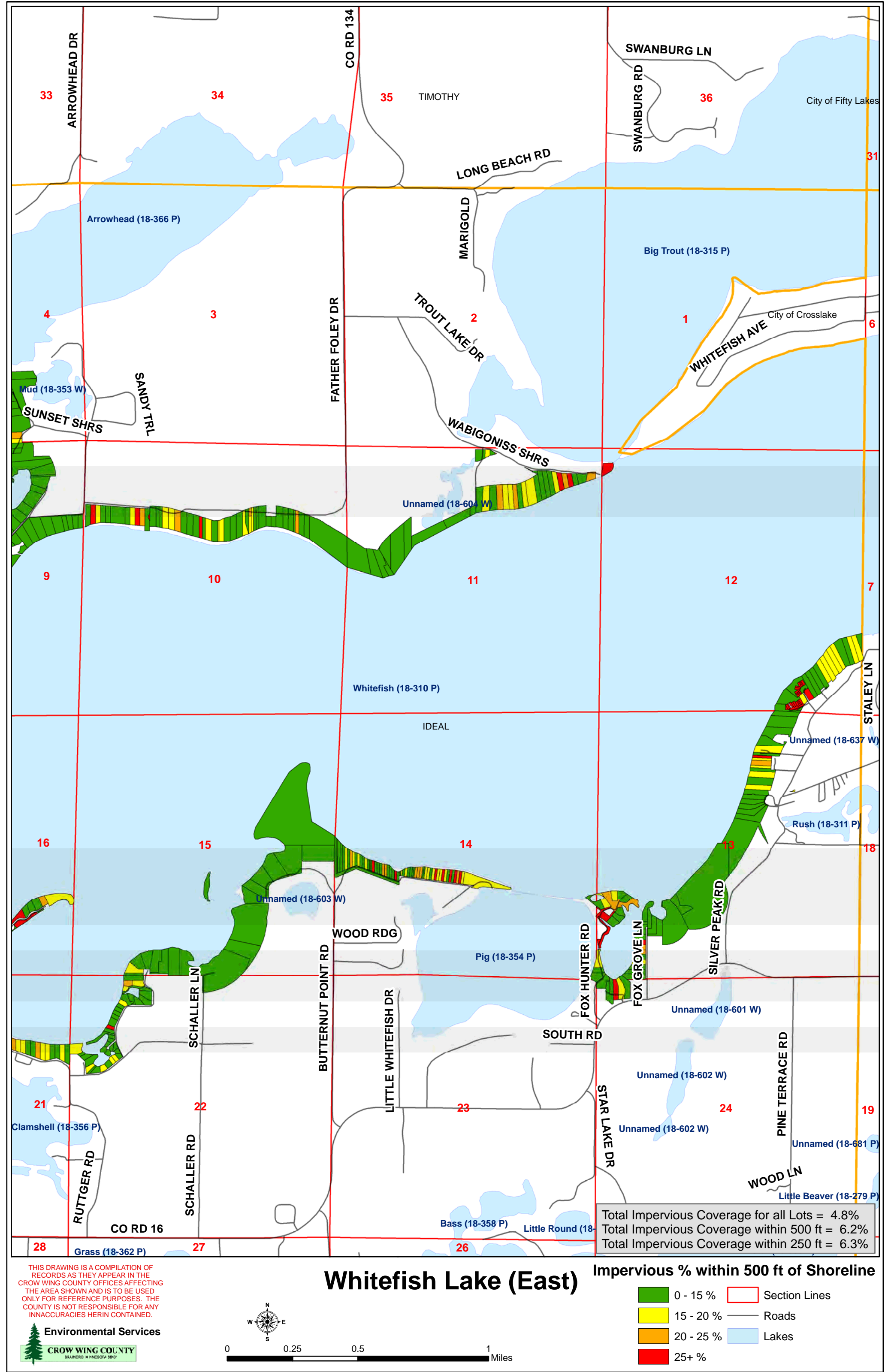
Impervious Surface Coverage by Parcel



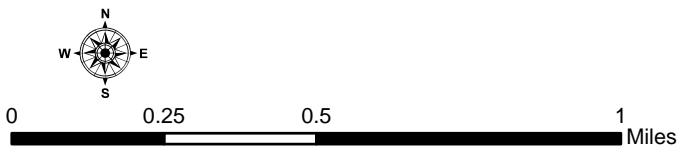
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# Whitefish Lake (East)

## Impervious % within 500 ft of Shoreline

- 0 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25+ %
- Section Lines
- Roads
- Lakes



